Reality for those who can think

Rayleigh-corrected and true-color image of the Earth from the Japanese Himawari 8 satellite captured by the AHI sensor (2015)

396 proofs that the Earth is not flat

A colored, illustrated and sourced booklet of proofs to avoid being manipulated by dishonest, lying, deceitful, communitarian and sectarian individuals.

Collective Work

V0.1 revision 395 – Thursday 30rd September 2026 18:00 GMT+1
Creation date: 2024-09-02
English Edition (translated with the help of *Google Translate*) – Distro : Ἄτλας (ATLAS)

CC BY SA

TABLE OF CONTENTS

TABLE OF CONTENTS **2**
USEFUL INTERNET LINKS **10**
WHY THIS BOOKLET? **13**
ARGUMENTS/EVIDENCE AND PROOFS **18**
Non-composite photos of Earth **20**
(#001) Non-composite photos from the Japanese space agency JAXA 20
(#002) Non-composite photo by North Korean space agency NATA 22
(#003) Non-composite photos from the European Space Agency ESA 23
(#004) Non-composite photos from the Russian space agency ROSCOSMOS 24
(#005) Non-composite photo by Indian space agency ISRO 25
(#006) Non-composite photo from the Chinese space agency CNSA 26
(#007) Non-composite photos from the US space agency NASA 28
(#008) Non-composite photos of General Motors' V-2 n°13 32
Panoramas **34**
(#009) Manistique Lighthouse (USA) to Chicago (USA)/465 km 36
(#010) Baie du Dervin Sea (FRA) to Santander (SPA)/426 km 37
(#011) Rousse Island/Corsica (FRA) to Toulon (FRA)/274.13 km 38
(#012) Vevey (CHE) to Gland (CHE)/49.36 km 39
(#013) Rolle (CHE) to Thonon (CHE)/13.887 km 41
(#014) Dubaï/Burj-Khalifa (EAU) to Koweït (IRA)/853 km 43
(#015) Alam Salam Bridge (EGY) to Port Saïd (EGY)/46.45 km 45
(#016) Mont South Sister (USA) to Mont Rainier (USA)/300 km 47
(#017) Shape of planetary bodies and moons **50**
(#018) Gravimetry **51**
(#019) Size of continents/countries/states… **53**
Visual Horizon and Laws of Perspective (Curvature) **55**
(#020) Corsica from Cagnes-Sur-Mer/Nice (France) 60
(#021) Mont Canigou from Cagnes-Sur-Mer/Nice (France) 67
(#022) Alpes from the Pyrénées 73
(#023-030) Civil constructions and leakage points 79
(#031-034) Cargo ships on the Suez Canal and leak points Cargo ships on the Suez Canal and leak points 80
Civil constructions highlighting the curvature **82**
(#035) Lake Pontchartrain Bridge (United States) 82
(#036) Thorntonbank Wind Farm (Belgium) 85
(#037) Santa Barbara oil platforms (United States) 88
(#038) Ocean Monarch oil platform (Australia) 89
(#039) Pontchartrain High Voltage Power Line (United States) 92
(#040) Verrazzano-Narrows Bridge (United States) 94
(#041) Humber Bridge (England) 96
(#042) Akahsi Kaikyo Bridge (Japan) 98
(#043) David Taylor's Modeling Basin (United States) 101
(#044) University of Southampton Modeling Basin (United States) 104
(#045) Playa del Carmen/Cozumel (Mexico) 107
(#046) Bonneville Salt Flats (United States) 109
(#047) Burj Khalifa (Emirates) 112
(#048) London Underground Metro (United Kingdom) 116
(#049) Gotthard Base Tunnel (Switzerland) 120
(#050) Vasco de Gama Bridge 126
Means of transport and buildings disappearing below the horizon **127**
(#051-055) Boats disappearing below the horizon 127
(#056-061) Buildings disappearing below the horizon 134
(#062) Planes disappearing below the horizon upon landing 148

translation into english ongoing

(#063) Helicopter disappearing below the horizon upond landing 150
Simple empirical experiments for the curvature of the Earth 151
(#064) Eratosthenes' experiment (Alexandria-Syene) 151
Eratosthenes World School Annual Project 151
(#065) Al Biruni's Experience (Pakistan) 154
(#066) Bedford Level Experiment (United-Kingdom) 158
(#067) Rainy Lake Experience (USA-Canada) 159
(#068) Argentic photo of the curvature with a stratospheric balloon in 1932 161
(#069) Photo of the curvature with a weather balloon and GoPro camera 163
(#070) Distance from the local Sun and elementary trigonometry 166
(#071) Horizon-o-Matic 168
(#072) Plumb lines proven non-parallel 171
(#073) Spirit level 174
(#074) Declination of the horizon 177
(#075) Weather/Stratospheric balloon 179
(#076) Amateur rocket 184
(#077) Stick (gnomon) and shadow 187
Visibility of curvature from aircrafts 195
(#078) Flight Dubaï-Bengalurur Boeing 777 300ER (A6-EGO) (~10,000 meters) 197
(#079) Flight Lufthansa Airbus A321-231 (~11,000 meters) 199
(#080) Flight Frankfurt -Amsterdam (~10,000 meters) 200
(#081) Flight D.S.S (Gulfstream G-IV/N57HJ) above the Red Sea (~12,000 meters) 201
(#082) Concorde Flight (~15,000 meters) 202
(#083) Vol U2 (~21,000 meters) 204
(#084) Visibility of curvature from rockets 209
Observations of the angle of depression 211
(#084) Angle of depression from the ground 211
(#085) Angle of depression from an airliner 213
(#086) Depression angle via boat wakes 218
General Relativity 222
(#087) Hafele-Keating experiment 222
(#088) Gravity Probe B 225
(#089) Satellite TV Antennas 228
Plane routes 231
Circumpolar flights (with stopovers) 232
(#090) World Tour by the Poles by Pan Am PA50 (1977) 234
(#091) World Tour by the Poles TransPolar08 (2008) 237
(#092) World Tour by the Poles One More Orbit (2019) 238
(#093) Antipodal flights (with stopovers) 239
(#094) Direct QFA64 flight Johannesburg (South Africa) – Sydney (Australia) 242
(#095) Direct QFA63 flight Sydney (Australia) – Johannesburg (South Africa 244
(#096) Direct QR1364 flight Johannesburg (South Africa) – Doha (Qatar) 246
(#097) Direct MAU440 flight Port Louis (Mauritius) – Perth (Australia) 248
(#098) Direct MAU441 flight Perth (Australia) – Port Louis (Mauritius) 249
(#099) Direct SAA280 flight Johannesburg (South Africa) – Perth (Australia) 250
(#100) Direct SAA281 flight Perth (Australia) – Johannesburg (South Africa) 251
(#101) Direct QFA27 flight Santiago (Chili) – Sydney (Australia) 252
(#102) Direct QFA28 flight Sidney (Australia) – Santiago (Chili) 254
(#103) Direct QFA20 flight Manille (Philippines) – Sydney (Australia) 255
(#104) Direct QFA63 flight Sydney (Australia) - Johannesburg (South Africa) 256
(#105) Direct QFA64 flight Johannesburg (South Africa) – Sydney (Australia) 257
(#106) Direct MAU440 flight Port Louis (Mauritius) – Perth (Australia) 258
(#107) Direct MAU441 flight Perth (Australia) – Port Louis (Mauritius) 259
(#108) Direct SA280 flight Johannesburg (South Africa) – Perth (Australia) 260
(#109) Direct ANZ161 flight Auckland (New-Zealand) – Cairns (Australia) 261
(#110) Direct LAN804 flight Melbourne (Australia) – Santiago (Chili) 262
(#111) Direct LAN805 flight Santiago (Chili)– Melbourne (Australia) 263
(#112) Direct DTA747 flight Luanda (Angola) – Sao Paulo (Brazil) 264
(#113) Direct DTA748 flight Sao Paulo (Brazil) – Luanda (Angola) 265
(#114) Direct SA222 flight Johannesburg (South Africa) – Sao Paulo (Brazil) 266

translation into english ongoing

(#115) Direct SA223 flight Sao Paulo (Brazil) - Johannesburg (South Africa) 268
(#116) Direct TAM8058 flight Sao Paulo (Brazil) - Johannesburg (South Africa) 269
(#117) Direct TAM8059 flight Johannesburg (South Africa) - Sao Paulo (Brazil) 270
(#118) Direct LAN800 flight Auckland (Australia) - Santiago (Chili) 271
(#119) Direct LAN801 flight Santiago (Chili) - Auckland (Australia) 272
(#120) Test flight QFA14 Buenos Aires (Argentina) – Darwin (Australia) 273
(#121) Longest flight path and consistency 274
(#122) Aircraft nose tilt 277
(#123) Reflection of the Sun's rays under the fuselage of aircraft 281
Maritime Trips (cruises) 283
(#124) Definition of Nautical Mile/Nautical Mile 283
(#125) World Tour with MSC 285
Circumnavigation of Antarctica below the 60th parallel (south) 289
(#126) Mariusz Koper record (2018) 289
(#127) Lisa Blair record (2022) 291
(#128-136) Jules Verne Trophy 293
Vendée Globe 295
Sun 296
(#137) Local Sun and crepuscular rays / Faraday-Tyndall effect 296
(#138) Variation in the apparent size of the Sun 301
(#139) Sun and Moon on the Horizon and Laws of Perspective 307
Solar Eclipses 309
(#140) Hidden side of the Moon illuminated by the Sun 309
(#141) Size of shadow and penumbra 311
(#142) Analema (Equation of Time) 313
(#143) Shape of the apparent path of the Sun (solargraph) 321
(#144) Angle of displacement/Apparent rotation of the Sun 324
(#145) Sunspot orientation 327
(#146) Position of (apparent) sunrise/sunset 330
(#147) Sun Tracker 335
Solstices 337
Summer solstice 337
Winter Solstice 343
Equinoxes 348
(#151) Sunrise directions 348
Shadow of a stick 349
Path of a stick's shadow 353
(#152) Curvature of light (night/day inconsistency of the flat Earth) 354
Clouds 360
(#153-156) Mountain shadows projected onto the clouds 360
(#157-158) Cloud shadows cast onto the clouds 363
(#159) Shadows of condensation trails projected onto the clouds 365
(#160-161) Noctilucent clouds 366
(#162) Clouds cut by the horizon 369
(#163) Rising shadow at sunset 371
(#164) Catoptric effect 372
(#165) Reflections on water 373
(#166) Angular momentum violation 375
(#167) Refraction of the atmosphere 377
Planetary Transits 380
(#168) Transit of Venus 381
(#169) Mercury Transit 382
Solar constant 385
(#170) Solar constant 385
(#171) Solar Constant and Thermal Equilibrium 387
(#172) Solar Constant and Daytime Temperature 388
(#173) Solar Constant and Seasons 389
(#174) Time zones 391
Artificial satellites 393
(#175) Orbits problem 394
Lagrange points 395

translation into english ongoing

Geostationary satellites 397
(#176) G.P.S. (Global Positioning System) 400
(#177) Anomaly in stereoscopic topographical measurements 402
Moon 404
(#178) Shape of the Moon's shadow during lunar eclipses 404
(#179) Origin and color of the shadow during lunar eclipses 406
(#180) Variation in the apparent size of the Moon 408
(#181) Accuracy of lunar eclipse predictions 410
(#182) Lunar Eclipse observation points 414
(#183) Far side of the Moon (Moon's gravitational lock) 420
(#184) Orientation of the angles of the phases of the Moon 422
(#185) 24-hours Moon in Antarctica 425
(#186) Moon's visual ondulated parallax and diurnal libration 427
Solar Eclipses 432
Tides 434
(#187) Flat-Earth hypothesis without Gravity 434
(#188) Number of tides per day 438
Astronomical Observations and Navigation 440
(#189) Astrolabe 440
(#190) Sextant 442
(#191) Calf's head (navisphere) 444
(#192) Globus INK (Индикатор Навигационный Космический) 445
(#193) Equatorial mount 448
(#194) Night sky 452
Polaris (North Star) 456
(#195) Movement of the celestial North Pole 456
(#196) Angle of observation of the star Polaris 458
(#197) Sigma Octantis (North Star of the Southern Hemisphere) 459
(#198) Star declination 461
(#199) Apparent prograde and retrograde rotation of the sky 464
(#200) Anticrepuscular arch (Venus's belt) 466
(#201) Earth-Moon barycenter and thermal anomaly 468
(#202) Gegenschein (anti-solar glow) 470
(#203) Meteorite showers 472
(#204) Angular distribution of cosmic ray intensity 474
Standards Reference Documents/Technical Documents 477
(#205) National Society of Professional Surveyors (NSPS) convention 478
(#206) NOAA (National Oceanic and Atmospheric Administration) Glossary 480
(#207) Glossary of the BLM (Bureau of Land Management) 481
(#208) IHO (International Hydrographic Organization) Convention 482
(#209) FIG (International Federation of Surveyors) Standards 483
(#210) International Telecommunication Union 485
(#211) Surveying for Engineers 487
(#212) International standard ISO 1151 / Flight Mechanics 489
(#213) Swiss Commission for Geodesy 491
(#214) The Engineering Handbook 492
(#215) Techniques and Procedures for International Flights 493
(#216) Territorial paving (PLSS) 495
(#217) European Aviation Safety Agency 497
World Geodetic System WGS 84 499
(#218) Garmin G1000 Nxi Navigation System 500
(#219) Onboard Radar System 504
Honeywell IntuVue RDR-7000 Onboard Radar System 504
Collins WXR-2100 MultiScan™ Radar 507
(#220) Operating Instructions for Surveyor Total Stations 510
Leica TPS1100 Professional Series Total Station 510
Electronic GTS-220 and FTS 300 Series Total Station 514
(#221) Central Intelligence Agency (CIA) 516
(#222) Cybersecurity & Infrastructure Security Agency (CISA) 517

translation into english ongoing

(#223) Meteorology for Seafarers 519
(#224) Emergency Navigation 520
(#225) Railway construction 522
(#226) The meridian line of the Royal Observatory of Paris (definition of the meter) 524
(#227) Precision construction site LASER 527
(#228) RADAR JRC (Japan Radio Co., Ltd.) 529
(#229) Submarine Optical fibers 532
(#230) P and S seismic waves 536
Coriolis effect (pseudo-force) 541
(#231) Coriolis effect on hurricanes 542
(#232) Hurricane wall due to Coriolis effect 543
(#233) Coriolis effect on long-range ballistic shots 545
(#234) Coriolis effect on ocean currents 553
(#235) Foucault pendulum 554
(#236) Eötvös effect (Eötvös force) 559
(#237) Sagnac effect 562
(#238) Walker's Law and Garstang's Model 564
(#239) The Araucaria Columnaris tree 566
Electromagnetism 568
(#240) Magnetic dipole and convergence of field lines 568
(#241) Radar wave propagation 573
(#242) Schumann Resonances 575
(#243) Fresnel Zone 576
Atmosphere 578
(#244) The word "atmosphere" implies a… sphere 578
(#245) Atmospheric pressure 580
Gravity waves (volcanic eruptions) 582
(#246) Tonga volcano in 2022 582
(#247) Krakatoa volcano in 1883 586
LIGO gravitational wave detectors 590
(#248) Taking curvature into account in the construction of Caltech's LIGO 591
(#249) Taking curvature into account in the construction of VIRGO'S LIGO 594
(#250) Taking curvature into account in the construction of VIRGO'S Kamioka 596
(#251) Taking curvature into account in the Einstein Telescope construction project 598
(#252) Taking curvature into account in the Cosmic Explorer construction project 600
(#253) Gravitational wave time-distance 603
Particle accelerators 605
(#254) SPS CERN (Geneva/Switzerland) 605
(#255) LHC (Geneva/Switzerland) 607
(#256) Stanford's SLAC (United States) 609
(#257) Tevatron Fermilab (Illinois/United States) 611
(#258) Ko Energy-kasokuki Kenkyukiko (KEK) 613
(#259) Relativistic Heavy Ion Collider (RHIC) 615
(#260) SwissFel (free electron LASER) 617
(#261) International Linear Collider (project) 619
Softwares 621
(#262) AUTODESK AutoCAD Map 3D software measures curvature 621
(#263) Furuno ECDIS Marine Navigation System 623
(#264) ArcGIS Pro 625
Neutrino Detectors 629
(#265) T2K (Tokai to Kamioka/Japon) 629
(#266) DUNE (Deep Underground Neutrino Experiment/Illinois U.S.A.) 631
(#267) MINOS Experiment 633
(#268) CNGS (CERN Neutrinos to Gran Sasso/Italie) 639
Computer models 643
(#269) Horizon modelization (Blender) 644
(#270) Sky modelization (Stellarium) 652
Antarctica 655

translation into english ongoing

(#271) Distances between scientific stations 655
(#272-280) Solo crossings of Antarctica, either complete or partial 657
(#281) The Final Experiment (Antarctica) 659
Midnight Sun 667
Sports competitions 672
(#282) Vendée Globe 672
(#283) Daytona International Speedway 675
Reference books mentioning the globe 677
(#284) De Temporum Ratione (725) 677
(#285) Tractactus de Sphaera (1472) 679
(#286) The Seamans Secrets (1626) 680
(#287) The Philosophical Grammar: being a view of the present state of experimental Physiology, or Natural Philosophy (1738) 682
(#288) La Terre et les Mers – Description Physique du Globe (Hachette 1866) 684
(#289) Encyclopédie Terre (France Loisirs 1985) 686
(#290) Tout l'Univers (Hachette 1995-1996) 687
(#291) Encyclopédie Larousse (France Loisirs 1993) 688
(#292) Dictionnaire Visuel (français, anglais, allemand, espagnol, italien / 2003) 691
(#293) Reference World Atlas (2016) 692
(#294) Encyclopedia of Solid Earth & Geophysics (2021) 693
(#295) Wikipedia General Encyclopedia (2024) 694
(#296) Globes in schools and museums 695
Logos 698
(#297) OECD Logo 699
(#298) International Monetary Fund Logo 699
(#299) Logo of the International Court of Justice 700
(#300) FIFA logo and Football World Cup 701
(#301) Hockey World Cup 702
Liberia Seaman's Identification and Record Book 703
(#302) Announcement that the Earth is a globe by the Flat Earth Society 704
(#303) The greatest empire of all time used globes 705
Religious texts and objects that confirm the globe 707
(#304) Hinduism confirms the globe 707
(#305) Pastafarianism confirms the globe 708
(#306) Medieval Christian art confirms the globe 710
(#307) Christianity validates the globe in the Douai Bible of 1609 713
Islam confirms the globe 717
(#308) Hanbali school of thought: consensus of scholars (Sunni school) 717
(#309) Ibn Taymiya (1263/Hanbali school) 719
(#310) Abou Muhammed Ibn Hazm (994/Zahiri school) 721
(#311) Muhammad al Idrisi (1100/Sunni school) 722
(#312) Shams ad-Dīn adh-Dhahabī (1274/Sunni school) 723
(#313) Al-Ghazāli (1111/Sunni school) 724
(#314) Ibn al-Qayyim (1292/Sunni school) 725
(#315) Fakhr al-Din al-Razi (1149/Sunni scholar) 726
(#316) Al-Masudi (896/Sunnite) 727
(#317) Qibla 728
(#318) Fatwa number 242935 731
(#319) Catholicism (the Vatican) confirms the globe. 732
The report on artificial intelligences 735
(#320) Open AI ChatGTP 735
(#321) Microsoft Copilot 736
(#322) Google Gemini/Bard 737
Apple Artificial Intelligence 738
(#323) Meta AI 739
(#324) Consensus.App 740
(#325) Grok 2 742
(#326) Claude 743
(#327) DeepSeek 744

translation in english ongoing

(#328) Mistral 745
(#329) Apertus 746
Citations de scientifiques et ingénieurs qui confirment le Globe 747
Citations de scientifiques 747
(#330) Aristote (philosophe et polymathe) 748
(#331) Claude Ptolémée (astronome, astrologue, mathématicien et géographe) 748
(#332) Archimède (mathématicien, physicien, ingénieur, astronome) 748
(#333) Strabon (géographe, philosophe) 749
(#334) Galileo Galilei (mathématicien, géomètre, physicien et astronome) 749
(#335) Isaac Newton (polymathe, physicien, astronome, alchimiste, théologien et auteur) 749
(#336) Nicolas Copernic (astronome polonais ou allemand, également chanoine, médecin et mathématicien) 749
(#337) Leonhard Euler (mathématicien, physicien, astronome, géographe, logicien et ingénieur) 749
(#338) Joseph-Louis Lagrange (mathématicien, physicien et astronome) 749
(#339) Pierre-Simon, marquis de Laplace (ingénieur, astronome, philosophe, physicien) 749
(#340) Siméon Denis Poisson (mathématicien et physicien) 750
(#341) Jean-Baptiste Joseph Fourier (mathématicien et physicien français) 750
(#342) Albert Einstein (PhD en physique, Professeur, Prix Nobel de Physique) 750
(#343) Auguste Piccard (PhD en physique de l'ETHZ) 750
(#344) Richard Feynman (PhD physicien américain) 750
(#345) Edgar Dean Mitchell (PhD, ingénieur en aéronautique et astronautique du MIT) 751
(#346) Hans Volland (PhD, professeur, Institut de radioastronomie, Université de Bonn, Allemagne) 751
(#347) Olena Kuzii et Andrij Rovenchak (département de physique théorique, Université nationale Ivan Franko de Lviv, Ukraine) 751
(#348) Bowie William (diplômes honorifiques de l'Université d'Edimbourg) 751
(#349) Gates, W. Lawrence (PhD en météorologie du MIT) 752
(#350) He Xianqiang et Cie (PhD en électronique physique) 752
(#351) Niklas Axel Mörner af Morlanda (doctorant en géologie quaternaire, l'université de Stockholm) 752
(#352) William Edward Featherstone (PhD, professeur de géodésie) 752
(#353) John Beckman (PhD en physique théorique et astrophysique à l'université d'Oxford) 752
(#354) Michio Kaku (PhD en physique) 753
(#355) Brian Cox (PhD en physique) 753
Citations d'ingénieurs, pilotes, médecins et sportifs de l'extrême 754
(#356) Alexeï Lenov (pilote de l'armée de l'air de Chuguev, astronaute) 754
(#357) Cheikh Muszaphar Shukor Al Masrie bin Sheikh Mustapha (médecin et astronaute) 754
(#358) Felix Baumgartner (parachutiste autrichien, casse-cou et Base jumper) 756
(#359) Buz Carpenter (diplômé de l'Académie de l'USAF, pilote de SR-71 Blackbird) 756
(#360) Anderle, Richard J. (laboratoire d'analyse numérique et computationelle, USNSWC) 756
(#361) Zhiping Lu et Al. (département de géodésie, Institut universitaire d'ingénierie de l'information de topographie et de cartographie, Zhengzhou, Chine) 757
(#362) Nikola Tesla (inventeur) 757
(#363) Guglielmo Marconi (inventeur, prix Nobel de Physique 1909) 758
(#364) Maxime Fontaine (pilote de ligne) 759
(#365) Jean-Pierre Petit (ingénieur) 760
(#366) Wernher von Braun (ingénieur) 761
Citations de navigateurs/skippeurs qui confirment le Globe 764
(#367) Klaus Luhta (capitaine marine marchande) 764
(#368) Robert Lehmann (entrepreneur, marin) 765
(#369) Linda Lindenau (navigatrice, formatrice en navigation) 765
(#370) Vikash Kumar (entrepreneur, ingénieur maritime en chef) 766
(#371) Zbigniew Gutkowski (navigateur/compétiteur professionnel) 767
(#372) David Burch (navigateur/compétiteur professionnel) 768
Vidéos/Interviews avec scientifiques, pilotes, marins, ingénieurs confirmant la courbure ou le globe 770
(#373) Auguste Piccard (doctorat en physique de l'ETHZ, Suisse) 770
(#374) Jean-Pierre Goux (mathématicien, ingénieur) 771
(#375) Olivier Jamet (mathématicien, ingénieur) 772
(#367) Alain Riazuelo (astrophysicien, chargé de recherches CNRS, à l'institut d'astrophysique de Paris) 773
(#376) Hasard Lee (pilote de chasse F16 et F35) 774
(#377) Arnaud Boissières (navigateur/compétiteur professionnel) 775
(#378) Loïck Peyron (navigateur/compétiteur professionnel) 776
(#379) Gary Baumgardner (pilote de ligne) 777
(#380) Lucas Fanjaud (pilote commercial et instructeur de vol) 778
(#381) Nicolas Lunven (navigateur/compétiteur professionnel) 779
(#382) Amiral Bird (aviateur/officier navigateur 780
(#383) Pierre-Henri Chuet (ancien pilote de chasse franco-canadien) 781
(#384) Mathias Gnida (pilote certifié, spécialiste dans la gestion de la peur de l'avion) 782

translation in english ongoing

(#385) Erick Van Pratt (pilote certifié, commandant sur Airbus A320) 783
(#386) Barry Schiff (ancien pilote de ligne chez TWA) 784
(#387) Blain Dapper (capitaine chez American-Airlines sur Boeing 738) 786
(#388) Kenneth Card (pilote de ligne chez Delta Air Lines, ancien pilote de l'US Air) 787
(#389) Sébastien Simon (skipper français, ingénieur strucvtures) 788
(#390) Shawn Walsh (ancien pilote de F-16) 789
(#391) Raja Katz (pilote de ligne sur Airbus) 791
(#392) Sultan ben Salmane (premier musulman à avoir été dans l'espace) 793
(#393) Absence de preuves de la Terre plate 796
Preuves NHST de la courbure du globe 797
Family Wise Error Rate (correction de Bonferroni) 800
(#394) Théorème Isopérimétrique 801
QUESTIONS THAT FLAT-EARTHERS PROPONENTS NEVER ANSWER 802
CARSEY and YouGov RESEARCH 805
SYNTHESIS AND CONCLUSION 808
BIBLIOGRAPHY 814
Summary of DOI numbers 819
TABLE OF FIGURES 823
CHANGE LOG (for major versions only) 832
ADDENDUM 834
(#A01) Making water stick on a ball 834
(#A02) 24-Hour Earth Video 842
ERRATUM 844
HUMOR 845
INDEX 935

translation into english ongoing

USEFUL INTERNET LINKS

An updated version of the English distro of this booklet in PDF format can be found here :

An audio version (podcast) of the contents of this book can be found here:

…

A video version of the contents of this booklet can be found here:

…

Otherwise here is a list of useful links when you discuss or debate with flat-earthers:

- English website dedicated to the debunk of flat-earther lies:
  https://flatearth.ws
- A few YouTube channels dedicated to the debunk of flat-earther lies:
  https://www.youtube.com/@DaveMcKeegan
  https://www.youtube.com/@SciManDan
  https://www.youtube.com/@MCToon
- A YouTube video that expose the the Eric's Dubay 200 lies about flat Earth:
  https://www.youtube.com/watch?v=UBfEhIJLYfY
- The biggest TikTok account dedicated to the debunk of flat-earther lies:
  https://www.tiktok.com/@flatearthrealiti
- Website where you can have fun with an interactive 3D flat Earth model:
  http://walter.bislins.ch/bloge/index.asp?page=Flat+Earth+Dome+Model
- Horizon online calculator without refraction:
  https://www.omnicalculator.com/fr/physique/calculateur-courbure-terre
- Horizon online calculator with refraction:
  http://walter.bislins.ch/bloge/index.asp?page=Advanced+Earth+Curvature+Calculator
- Globe Earth VS Flat Earth distance online calculator:
  https://www.geogebra.org/m/Ytxedv6s
  http://walter.bislins.ch/bloge/index.asp?page=Distances+on+Globe+and+Flat+Earth
- Eratosthenes Project website:
  https://eratosthenes.eu/wordpress/measurements-archives/
- Real-time aircraft trajectory website:
  https://www.flightradar24.com

translation into english ongoing

- Real-time boats trajectory website:
  https://www.marinetraffic.com

- A website that allows you to position yourself in 3D on mountains and simulate the view (taking curvature into account).
  https://peakvisor.com

- Point to point simulator of atmospheric refraction:
  https://atmospheric-refraction-simulator.pages.dev/

- Map of submarine fiber optic cables:
  https://www.submarinecablemap.com

- Dynamic map of pressures, winds and others:
  https://www.ventusky.com

- Real-time non-composite image of the Earth from the Himawari 8 satellite in geostationary orbit:
  https://himawari8.nict.go.jp

- Reference website that gives us the positions of the Sun throughout the day, as well as its apparent size:
  https://www.geogebra.org/m/C9BcVgd4

- French-speaking YouTube channel with videos that debunk the flat Earth:
  https://www.youtube.com/@fredaves268/videos

- Website with levels (topographic maps) of the places of your choice:
  https://fr-fr.topographic-map.com

- Website generating 3D panoramas based on real topographic data:
  https://www.udeuschle.de/panoramas/makepanoramas_en.htm

- Online Calculator of the angle of depression based on several factors:
  https://flatearthinsanity.blogspot.com/p/fei-horizon-calculator.html

- Website for a forecast or history of tides:
  https://www.tide-forecast.com

- Link to download the famous free open-source software Stellarium:
  https://stellarium.org

- Web page to interactively simulate dark areas on Earth on the globe:
  https://in-the-sky.org/twilightmap.php

- Web page to see the Earth's geoid by amplifying the gravitational anomalies:
  https://www.g-red.eu/geoid/geoidViewer.html

- An Instagram account with funny memes about flat Earth and its supporters:
  https://www.instagram.com/memes_terre_plate?igsh=MTY0cnFiMXZzeHJ0Mw==

translation into english ongoing

- An analemma generator:
  https://alokm.com/astro/analemmagenerator.html

- A website to pick a place in the world and get the sun path and also the shadows of a sundial interactively at any moment of time:
  https://www.sunearthtools.com

- Every mountain, building and tree shadow in the world simulated for any date and time:
  https://shademap.app

- An online flat Earth simulator:
  https://alanspaceaudits.github.io/conceptual_flat_earth_model/

- A small, animated, and interactive planetarium useful to explain some concepts:
  https://theskylive.com

- A German shop where you can buy a nice gift for young children :

  https://www.astroshop.de/fr/jouets/celestial-buddies-terre/p,55121

translation into english ongoing

WHY THIS BOOKLET?

The flat Earth model, or perhaps this mountain of lies, has continued to expand and has succeeded in persuading many people to throw logic out the window and make the reality of information nothing less than fantasy or impossibility.

Unfortunately, the belief in a flat Earth, despite the scientific evidence of its oblate sphere shape (approximation of a geoid), persists and this is because several factors and motivations are hidden behind the deception:

1. **Religious indoctrination:** The literal reading of the texts of the Abrahamic sects (Bible, Koran, Torah, Talmud etc.) but also of religions such as Hinduism are very clear on the fact that the Earth was considered flat at the time of their writing. Unfortunately, a significant percentage of individuals cannot reject these texts which are the basis of their dogma and their faith by indoctrination and consequently must reject any scientific evidence which contradicts these dogmas.

   Geocentrism can lead to a religious and fantasized view of reality, where life is only worth living once after death and therefore has no intrinsic purpose. This can diminish the importance of developing empathy, rationalist morality and promotes a dogmatic and erroneous perspective of humans and their complexity.

2. **Distrust of institutions:** Some people believe that governments and scientific institutions hide the truth for reasons of control or manipulation (Toward a Cultural Psychology of Conspiracy Theories:, 2024). In reality, these people have often had negative experiences with state administration or cannot stand having to go to work every day to live (because flat Earthers[1] often seem to have a checkered past involving rape, drugs, prison, police custody, domestic violence, academic failure, etc.).

   There are also believers who think that governments want to replace the dogmas and gods they believe in and therefore that governments want to eliminate them and their beliefs. In reality unfortunately their beliefs are just collateral damage of Science.

3. **Influence of social networks:** Online platforms allow the rapid spread of conspiracy theories (see the following video https://www.youtube.com/watch?v=vvsJRuNemWE which sums up the conspiracy theorists' syndromes relatively well), including that of the flat Earth.

4. **Need for belonging and attention:** Adhering to a fringe theory can provide a sense of community and identity to those who feel excluded or misunderstood by mainstream society (Motivated ignorance and social identity threat: the case of the Flat Earth, 2023).

5. **Lack of scientific knowledge:** A limited understanding of basic scientific principles can make some people more likely to believe alternative explanations.

translation into English ongoing

[1] We will use the expression “flattard” starting from now instead of “flat Earther” as it is shorter to write and described the much better.

6. **Hatred of intellectualism (anti-intellectualism):** Some individuals have failed to obtain a remunerative and passionate profession due to their lack of intellectual capacity which has caused them to fail in the scientific branches at school and having as a consequence the inability to obtain the diploma of their choice (and therefore the profession related to it!). These individuals have then developed a hatred and jealousy against intellectuals and intellectualism in general. Unable to increase their intellectual capacities, they then try to bring people down to their own level. In other words they bring people down to their level, to make themselves feel better.

7. **Source of income:** Individuals take advantage of the merchandising of their videos, books and conferences on the flat Earth to have comfortable incomes (we were able to determine that in the USA some have earned more than half a million US dollars thanks to the flat Earth business). In reality these people are just charlatans who take advantage of the naivety and ignorance of a section of the population to make a significant source of income (some people have become millionaires thanks to this or have been able to finance absurd projects).

8. **Troll:** There are people who troll (pretend to be someone they are not) just as a hobby (don't feed the trolls!).

   Among these, some have as their occupation trying to beat their personal record of likes, comments and shares, and for this any means is good (and what plays on the sensitive string of feelings and religions and the conflict between religions and sciences seems to work rather well…).

9. **Psychological discorder:** A significant percentage of the world's population suffers from psychological disorders, some of which prevent normal analytical abilities (paranoid schizophrenia - paraphrenia according to DSM-IV code 295.30, paranoid delusion, bipolarity, mythomania, depression, intermittent explosive disorder, Down's syndrome, Alzheimer's, Parkinson's, senility, NMDA[2] excess, intellectual disability, delusions of persecution, traumas that leads to escape reality, dementia[3], etc.).

10. **Addictions:** People who consume or have consumed drugs (weed, cocaine, LSD, etc.) / medications or alcohol excessively can see their cognitive abilities significantly diminished, leading them to no longer have any discernment between the real world and their imagination. Furthermore, a study has shown that individuals who consumes psychedelic drugs are statistically more inclined to believe in conspiracy theories. (Alternative beliefs in psychedelic drug users, 2023).

11. **Anarchism:** Some people are also anarchists. As a reminder, this means that they seek to abolish any form of government or authority by any means whatsoever (chaos, discrediting, lies, manipulation).

12. **Backlash effect:** Religions are collateral damage of science. Indeed, science has been constantly proving the claims of religions false for about 2500 years. Some religious

translation into english ongoing

[2] N-methyl-D-aspartate is a molecule that acts as an agonist of the NMDA receptor, a type of glutamate receptor in the brain (source: Wikipedia).
[3] Called "neurocognitive disorder" according to DSM-V

people take it very badly that Science destroys their belief and therefore want to do the same by trying to destroy Science with their belief.

13. **Intelligence Quotient:** The IQ varies across the population. What is important to know in the context that concerns us here is that approximately 2.1% of the population is below 70 IQ and 0.1% below 55 IQ…. A scientific study has also shown that flat Earth supporters have an IQ significantly below the mean and the median médiane (Dunning–Kruger effect and flat-earthers: An exploratory analysis, 2023).

14. **Marginals:** Some people are “marginals” and reject any established system because they are against social, scientific and political normalization (they would like to be able to live without borders, without taxes and without justice).

15. **Neurodegeneration:** Neurodegeneration related to drug and alcohol use affects IQ, and even a sober person will suffer the effects of their youthful use for the rest of their lives. Studies have shown that regular use of certain substances, such as cocaine and cannabis, can have negative effects on cognitive functions, including memory, attention, and decision-making. These alterations can, in some cases, result in a decrease in IQ.

16. **Political and economic interests:** As demonstrated by several independent studies, religions have a turnover of more than 2,000 billion euros per year and millions of "jobs" depend on donations from people who are indoctrinated into them. Some States/Governments/Political parties therefore have every interest in continuing to communicate false stories and tales/legends of their doctrine, of which the Flat Earth is sometimes a part, to make people dream and make them believe that they are the center of the Universe and special and thus continue to take their money. In addition, by imposing a single model of understanding the World, religious elites reduce the diversity of critical and scientific thoughts. This homogenization prevents the emergence of critical thinking among believers, which locks them even more into their sect and their communitarianism. Believers are then conditioned to accept their dogma from childhood, which strengthens their faith and makes it difficult to accept that it is false.

    It is not for nothing that for several centuries, scholars/scientists and engineers who dared to go against the dogma of religions lost their funding, their academic positions and their credibility and that in extreme cases they were simply eliminated... Because too much money is at stake for religions!

17. **Dropout:** Some individuals have had a bumpy life path and for this reason were dropped out of school too early. They did not have the opportunity in their youth to attend compulsory school or were unable to meet the conditions for higher education. As adults, these same individuals – although interested in science – often have low incomes, rather than paying for private science (physics, astronomy, astrophysics) lessons between €15 and €70 per hour, they found a way by seeking confrontation on the flat Earth (while they know very well that it is an oblate sphere) on social networks, a strategy to have educated interlocutors who teach them science for free.

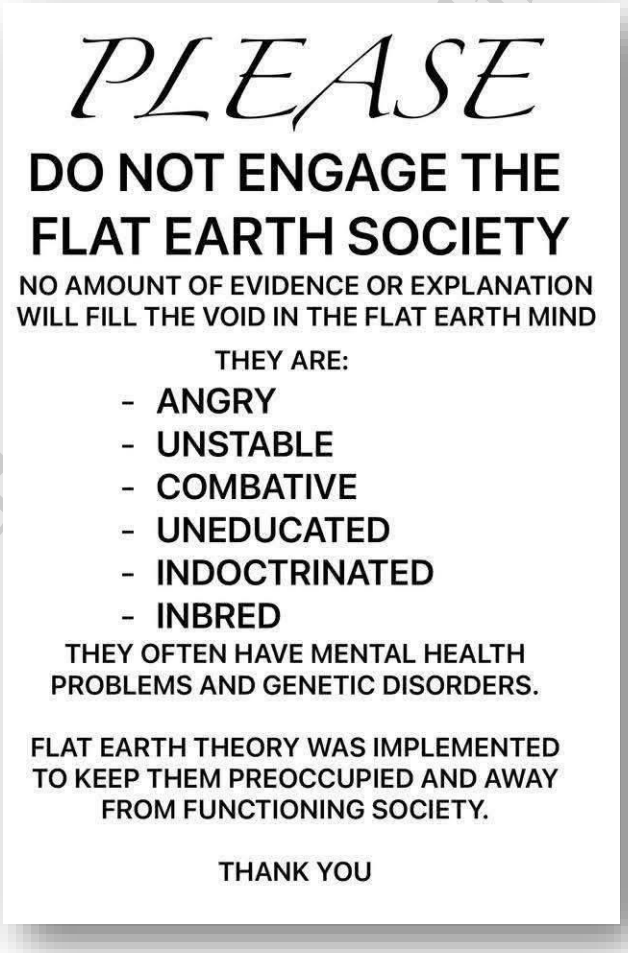
18. **Diversion/Decoy/Smokescreen:** To avoid to let engineers and scientists on social networks attached to reality and honesty communicate massively and publicly about the lack of proof of effectiveness of naturopathy, dowsing, acupuncture, clairvoyance,

translation into english ongoing

lithotherapy and other charlatan practices or the absurdity of the 34 revealed monotheistic religions and their scientific and historical errors, the supporters of these charlatan practices and religious beliefs whose income depends on them divert the attention and time of these experts by playing on the sensitive chord of their passion for Science by titillating them on an absurd and crude subject like that of the shape of the Earth.

19. **Hate against occident:** Even if multiple non-occidental scientists have proved in different ways that the Earth is not flat, some people living outside occident (or living in but born outside) have hatred sentiments because of occidental invasion, colonization or corruption of their native country. So attacking the globe Earth is an indirect way to attack the occidental education system (for example the name of the Islamist group "Boko Haram" means *Western education is forbidden*). Not to mention the immigrants in occidental countries who cannot find work corresponding to their qualifications because of the prevailing prejudices of employers and therefore find a convenient scapegoat through the Occident.

These beliefs are often reinforced by pseudo-scientific arguments and convincing videos that seem to challenge established facts.


PLEASE
DO NOT ENGAGE THE FLAT EARTH SOCIETY
NO AMOUNT OF EVIDENCE OR EXPLANATION WILL FILL THE VOID IN THE FLAT EARTH MIND
THEY ARE:
- ANGRY
- UNSTABLE
- COMBATIVE
- UNEDUCATED
- INDOCTRINATED
- INBRED
THEY OFTEN HAVE MENTAL HEALTH PROBLEMS AND GENETIC DISORDERS.
FLAT EARTH THEORY WAS IMPLEMENTED TO KEEP THEM PREOCCUPIED AND AWAY FROM FUNCTIONING SOCIETY.
THANK YOU

But is it dangerous? Beliefs or manipulations related to the flat Earth can have several negative consequences:

- **Rejection of science:** Adopting this belief can lead to a general distrust of science and experts, which can affect informed decision-making in other areas, such as health or the environment, and put the health and even lives of individuals and social cohesion at risk.

- **Spread of misinformation:** Conspiracy theories, including flat Earth, can spread rapidly on social media, contributing to an environment where misinformation is commonplace and people who are not trained in information analysis can then be easily manipulated by charlatans and this can have a significant impact on their health or social cohesion with family and close friends.

- **Impact on education:** If these beliefs are transmitted to children (because a significant percentage of flat-Earthers withdraw their children from schools to homeschool them, which is unfortunately permitted by the government), they can harm their scientific education and their understanding of the world. Children are then excluded from the system and marginalized, which is a danger for social cohesion.

- **Social isolation:** People who adhere to fringe theories may find themselves socially isolated, as their beliefs may alienate them from friends and family.

- **Economic Losses:** Millions of dollars worldwide and a lot of joule power (electricity) is lost unnecessarily because of flattards. This money and electrical energy could be much better used for educational or underprivileged aid organizations, etc.

These dangers show the importance of promoting science education and critical thinking.

Besides that, it should be known that exposing the evidence for oblate Earth and debunk the lies and manipulations of the flat Earth supporters is a very amusing and recreational exercise for those who want to have fun with the basics of science and mathematics!

This little booklet (or guide) will therefore be of use to teachers, facilitators and science enthusiasts who have to deal with numerous misconceptions, beliefs or fake news about the shape of the Earth.

Note: Anyone wishing to translate this document into a language other than French or English can contact us to have the original after we have ensured that you have no bad intentions (the document was purposely made with Microsoft Word and therefore with poor visual quality and not with LaTeX and its perfect visual quality to be easily modifiable and translatable by the greatest number).

Warning

This booklet cannot be sold. The copyright of the text and images means that it must remain free.

translation into english ongoing

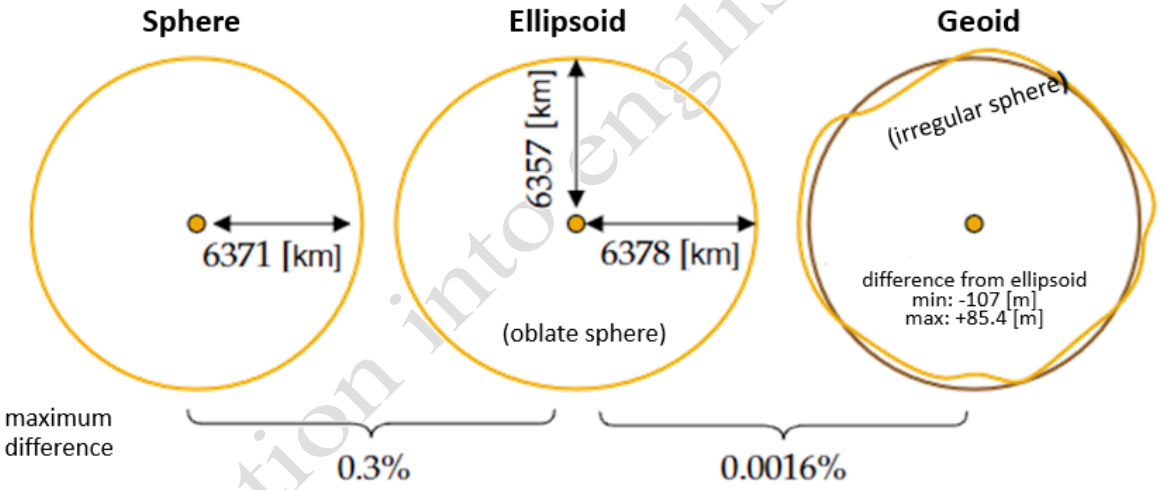
ARGUMENTS/EVIDENCE AND PROOFS

There are currently in this booklet 77 categories of arguments/evidences/proofs (independent) and 391 arguments/evidences/proofs if not grouped. Below is the detailed list, with scientific bibliographic references (DOI number included!) and illustrations (with sources and authors included!).

The proofs in this book have their respective numbers as names! So if someone asks you for the names of the proofs you can just give them the corresponding number.

The definition of the word "proof" in this booklet aligns with that of flat-Earthers (and is therefore obviously very far from its usual academic usage). *For flat-Earthers, a "proof" is either a quote, an opinion, a photo, a video, a book, a document, a sensory or visual experience, or a rhetorical statement.* Note that this definition does not include the concept of "scientific experimentation"... since no flat-Earther in the World has conducted one to date since the existence of flat-Earth believers.

Before we begin, let's first do a little reminder:



Caution ! The list of proofs that follow is not exhaustive because in reality we could come up with an almost infinite number of proofs/evidences that the Earth is an oblate sphere but we have only taken the most sympathetic, educational examples but also sometimes "proofs" such as those requested by flat-earthers (yes, the latter consider that quoting a scientist, an engineer, a pilot, a book or a sailor is a "proof"... 🤦).

translation into english ongoing

Let us remind that there is a $3,000,000,000 give away from Tim Boyle (C.E.O. of Columbia Sportswear) to anyone that proofs scientifically that Earth is flat (offer made in December 2025, and we bet that no one will come forward to claim the amount even in 10,000 years because there is no proof of a flat Earth):

translation in progress

Non-composite photos of Earth

Below we will only show non-composite images of Earth photos (i.e. photos made in a single shot) from several independent space agencies (with their own launchers) clearly showing for those who have no vision problems that the Earth is not flat.

(#001) Non-composite photos from the Japanese space agency JAXA

We have direct, non-composite, true-color photos of the Earth's geoid from weather satellites such as - among others - the Japanese satellite launched by the Japanese space agency :

JAXA
Japan Aerospace Exploration Agency

that is Himawari-8 (this satellite orbits the Earth synchronously in a geostationary orbit at 140 degrees East at a distance of 35,786 kilometers:

https://himawari8.nict.go.jp

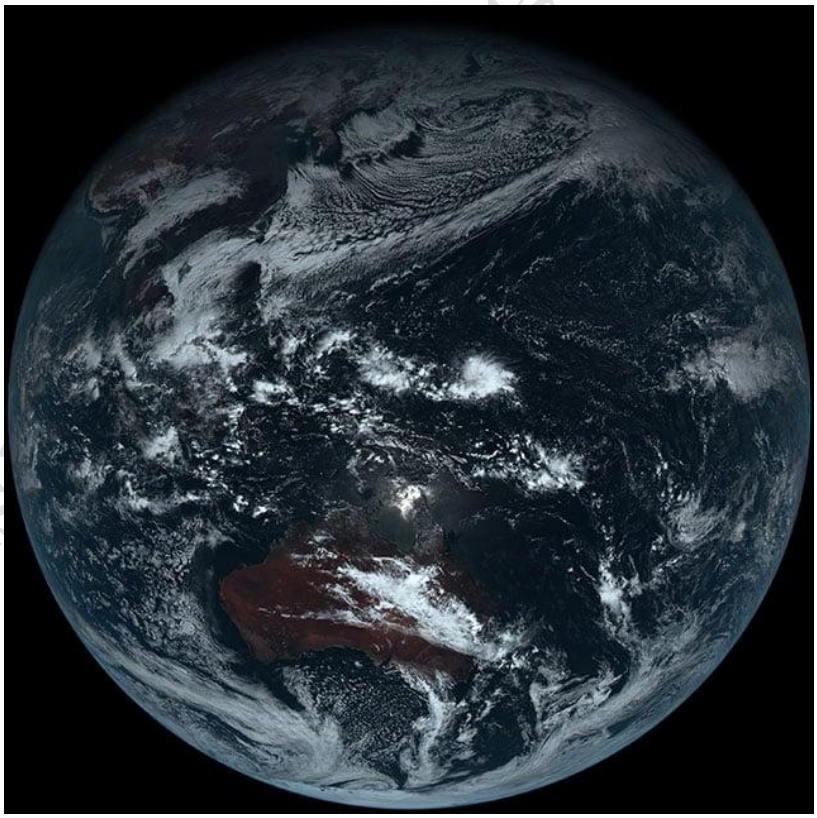
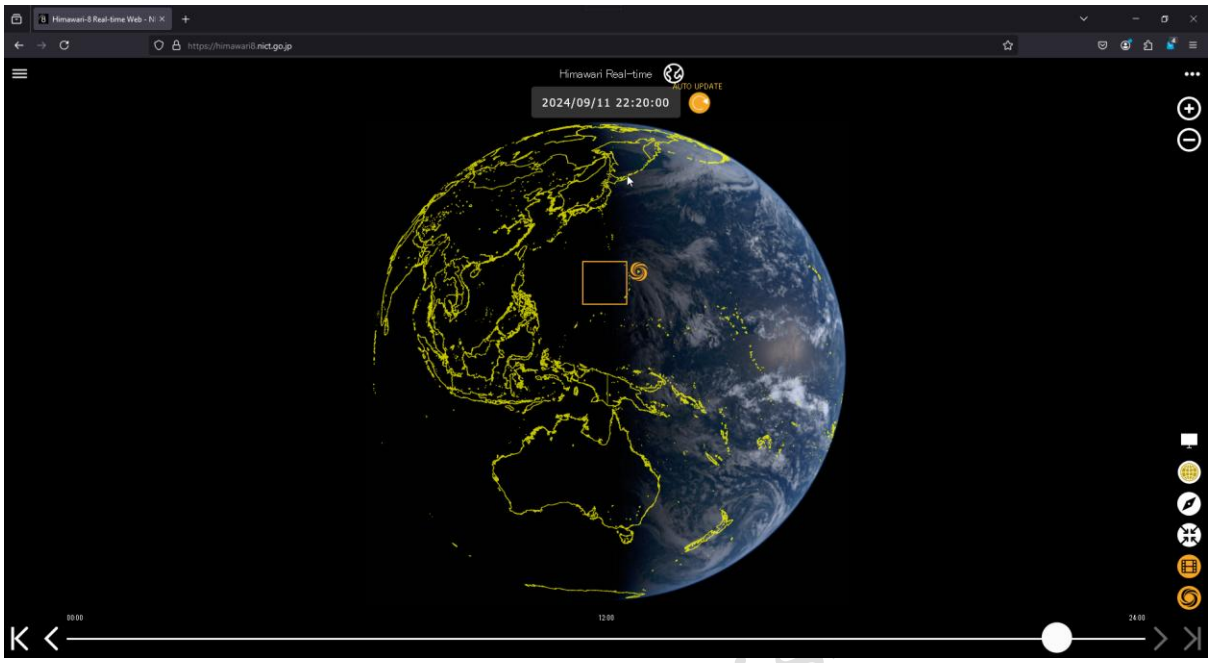


Figure 1 Non-composite satellite photo of Earth by Himawarri-8 (source: JAXA)

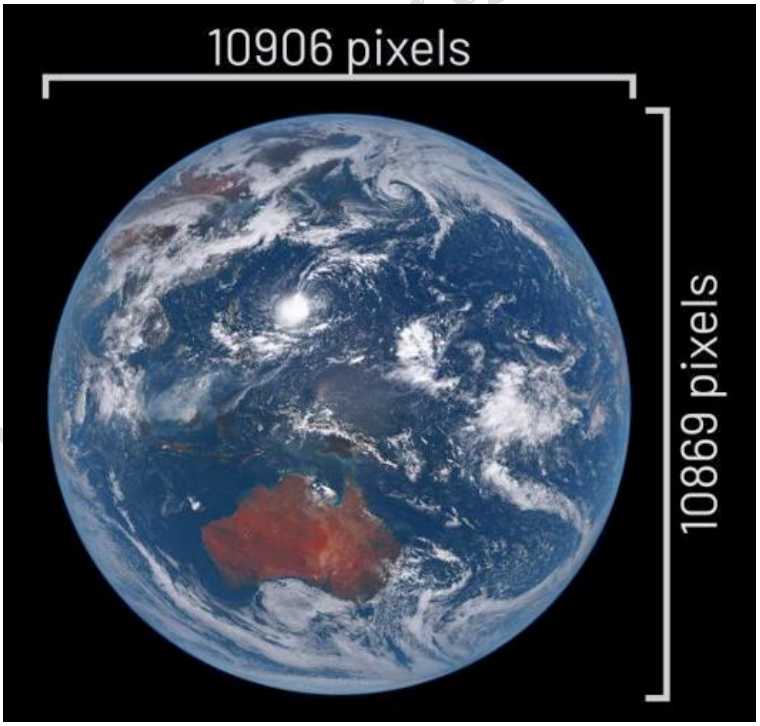
These images can be viewed in real time on the Japanese space agency's website, available here day or night:

translation in English ongoing

https://himawari8.nict.go.jp



Thanks to the 128 megapixel resolution of the Himawari 8 camera, it is even possible to playfully measure the Earth's ellipsoid factor:



We were able to measure the difference of 0.338%, very close to the WGS84 standard, which is 0.336%!

(#002) Non-composite photo by North Korean space agency NATA

Here is a non-composite photo taken of the Hwasong-12 missile in January 2022 from the North Korean space agency NATA:

https://militarywatchmagazine.com/article/guam-killer-space-took-pictures

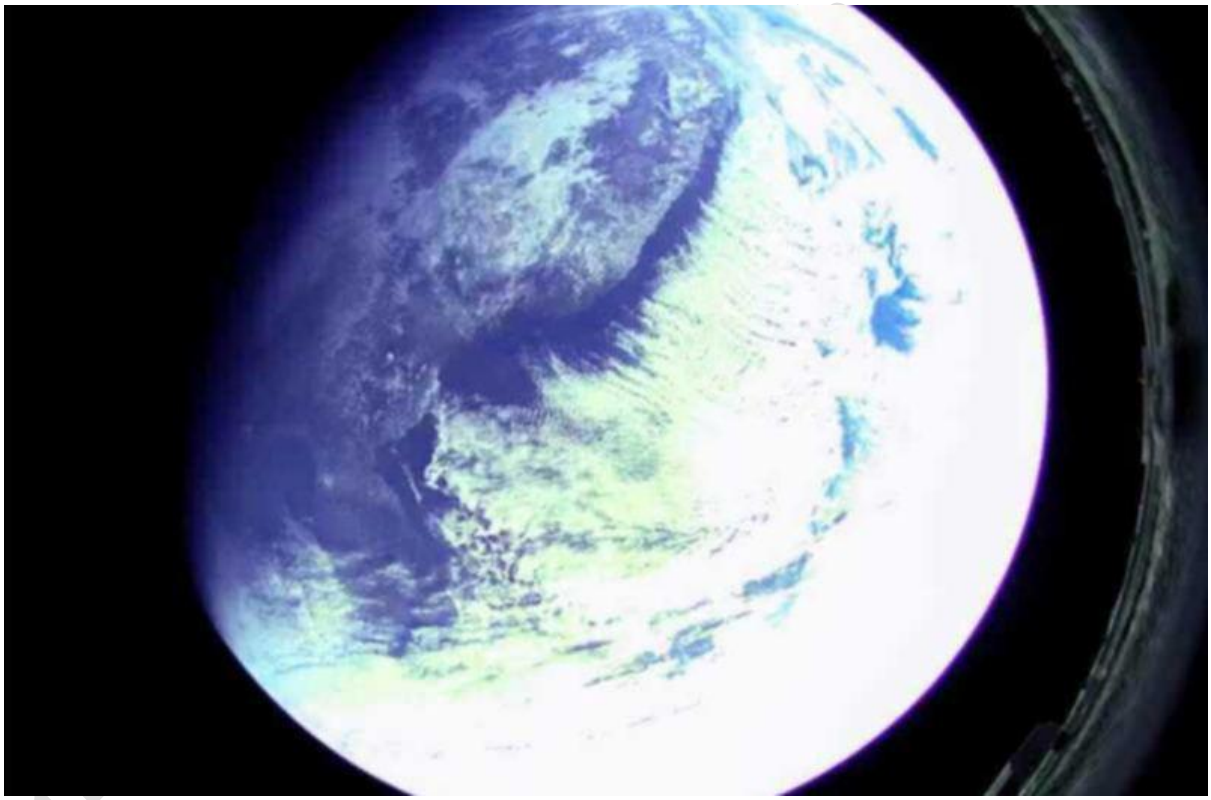


Figure 2 Photo taken with a camera on board of North Korea's Hwasong-12 missile during a test launch in January 2022 (Image credit: NKNews.org/KCNA)

ongoing

(#003) Non-composite photos from the European Space Agency ESA

First non-composite photo of the Earth by the Meteosat Third Generation – Imager 1 (MTG-I1)) satellite launched on December 13, 2022 by the European Space Agency (ESA) in geostationary orbit at 36,000 kilometers:

https://www.eumetsat.int/real-time-imagery/earth-view

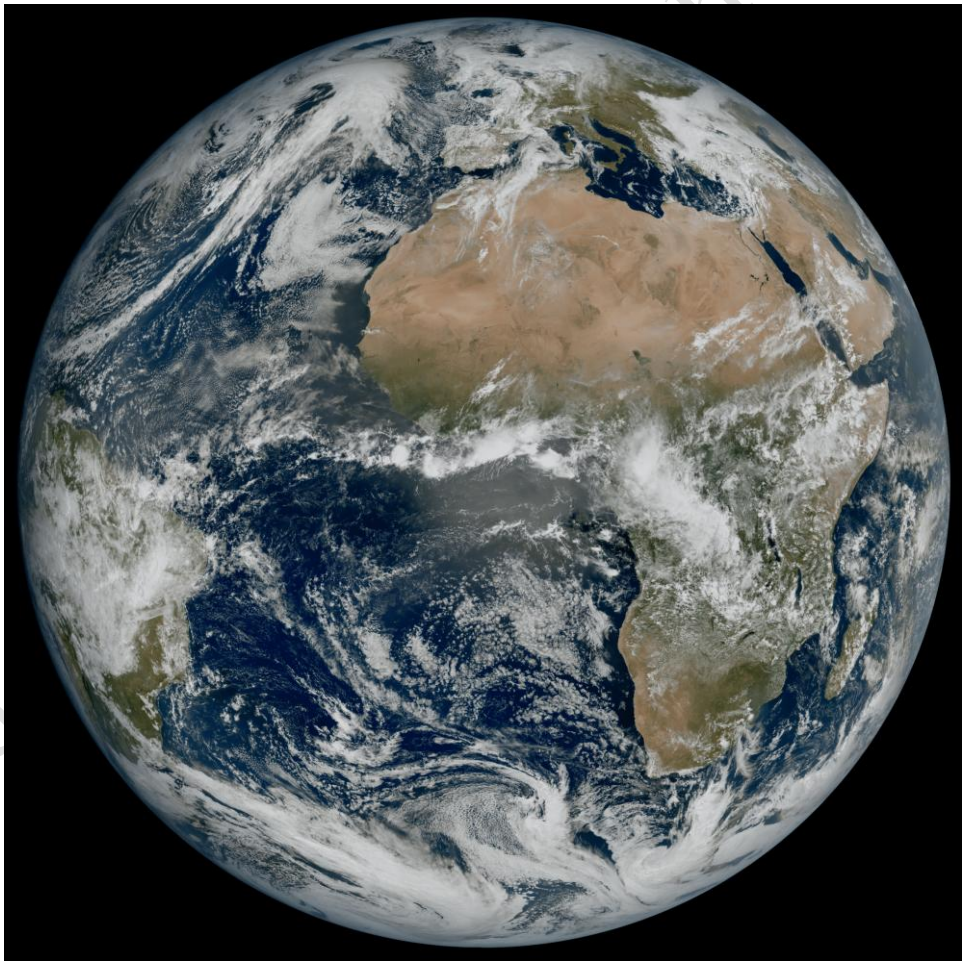


Figure 3 Non-composite photo of the Earth from the Meteosat Third Generation satellite – Imager 1 MTG-I1 (source: ESA/EUMETSAT)

There is here https://pics.eumetsat.int/viewer/index.html 35 years of day-to-day photo archives of the entire Earth from the EUMETSAT satellite.

(#004) Non-composite photos from the Russian space agency ROSCOSMOS

Non-composite photo of Earth from the Russian geostationary weather satellite Elecktro-L launched by the Russian space agency ROSCOSMOS from the Baikonur cosmodrome on January 20, 2011:

ROSCOSMOS

The original images from the Russian agency that manages the satellite are available here on their site hosted in Russia:

http://electro.ntsomz.ru/en/

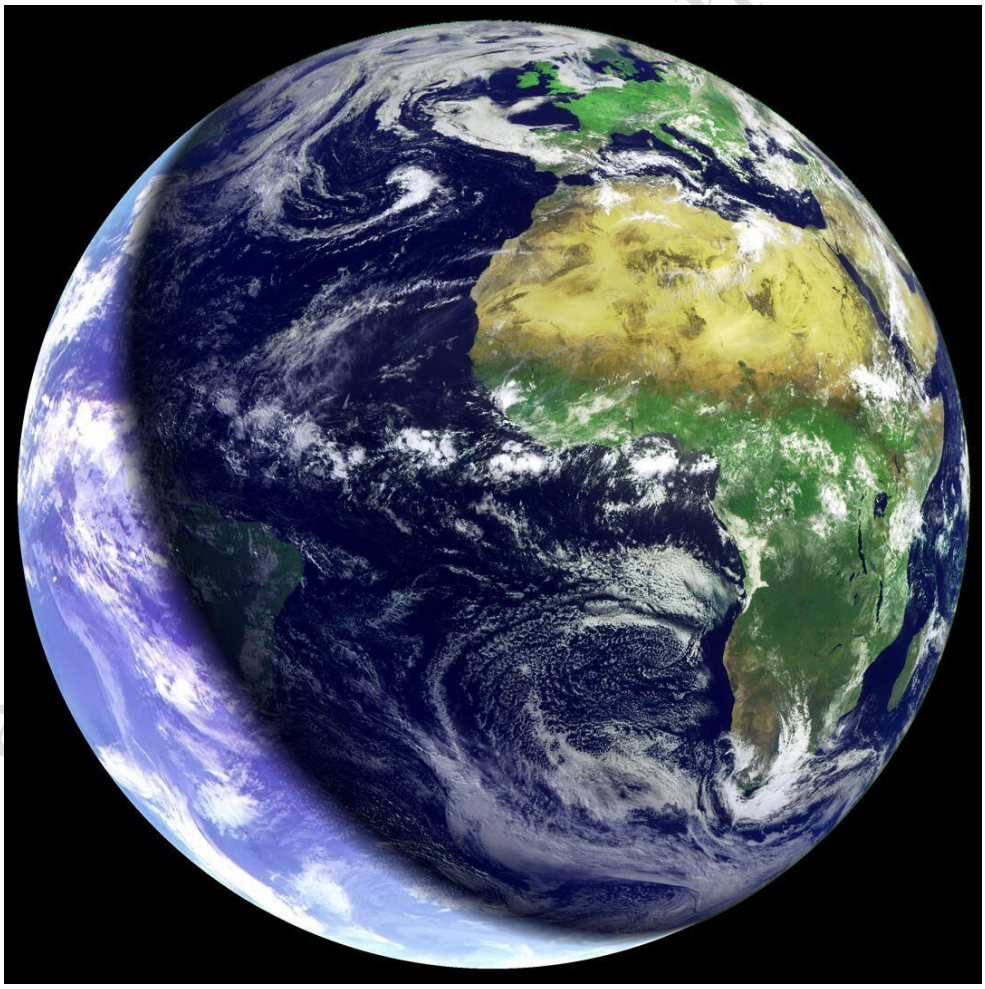


Figure 4 Non-composite photo of Earth from the Russian weather satellite Elecktro-L (source ROSCOSMOS)

(#005) Non-composite photo by Indian space agency ISRO

Chandrayaan-1 launched by the Indian space agency (ISRO) captured this photo of the nearly full Earth on March 25, 2009 at 07:03:03 UTC

https://chandrayaan.com/chandrayaan-1/chandrayaan-1-latest-updates/earth-from-chandrayaan-1s-camera-tmc.html

India is almost in the center of the picture:

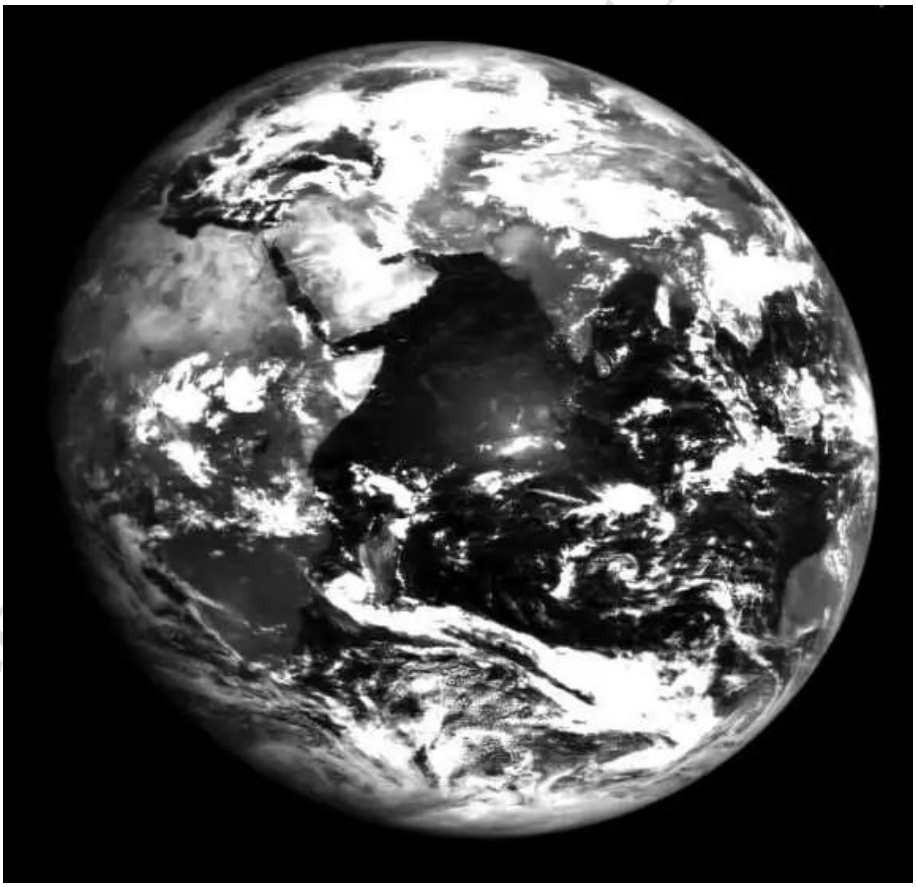


Figure 5 Photo of Earth by Chandraya-1 (source: ISRO)

(#006) Non-composite photo from the Chinese space agency CNSA

The Chang'e 5-T1 spacecraft, designed and built by the China Academy of Space Technology (CAST), consists of a service module based on the Chang'e 2 lunar orbiter design and a Chang'e 5 return capsule. This spacecraft took several unique (non-composite) photos during its journey and was launched on October 23, 2014, on a Long March 3C rocket of the China National Space Agency (CNSA):

ongoing

https://www.cnsa.gov.cn/english/n6465668/n6465670/c6840364/content.html

Figure 6 Non-composite photo of the Earth taken in November 2014 (source CNSA)

This spectacular space view below targeting the North African continent was captured by astronaut Tang Hongbo from the Chinese space station on July 30, 2021 (Tang Hangbo/CMSEO):

https://www.caixinglobal.com/2021-09-01/gallery-stunning-views-of-earth-from-shenzhou-12-101767149.html

translation into eng

(#007) Non-composite photos from the US space agency NASA

The famous original Blue Marble image is actually a non-composite photo. It was taken on December 7, 1972, by the astronauts of Apollo 17 launched by NASA:

https://visibleearth.nasa.gov/collection/1484/blue-marble

as they traveled to the Moon. The photo was taken from a distance of about 45,000 kilometers.

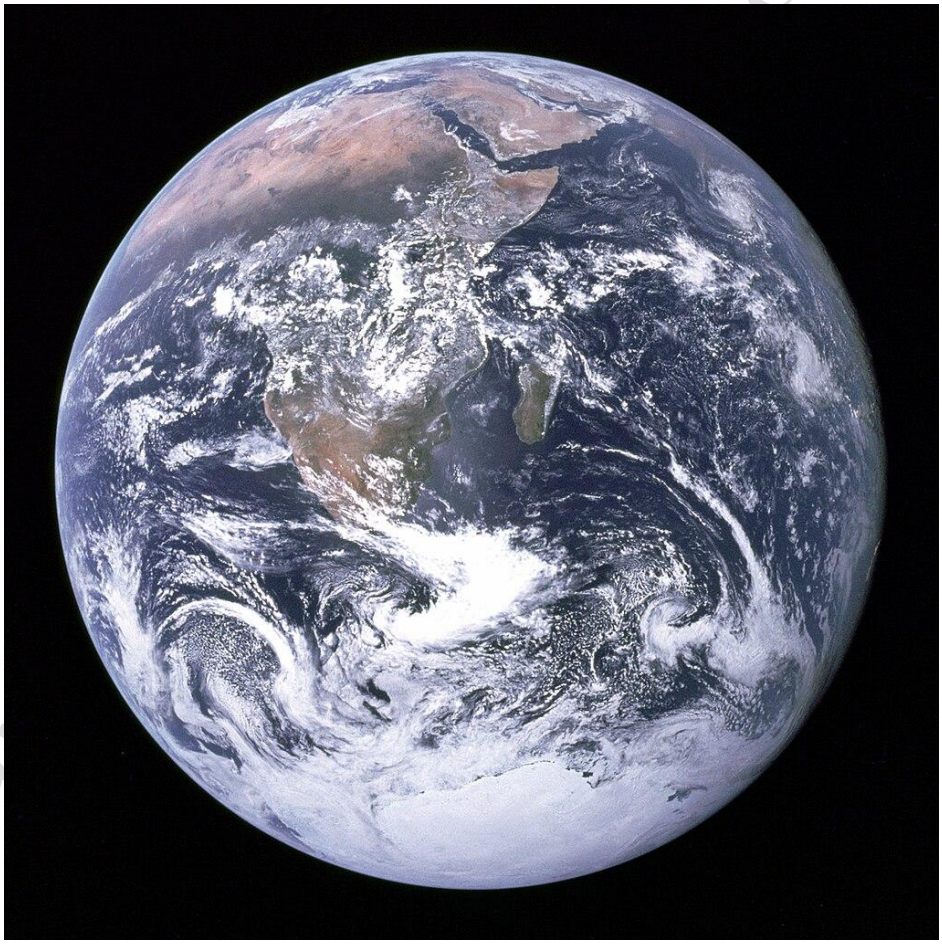
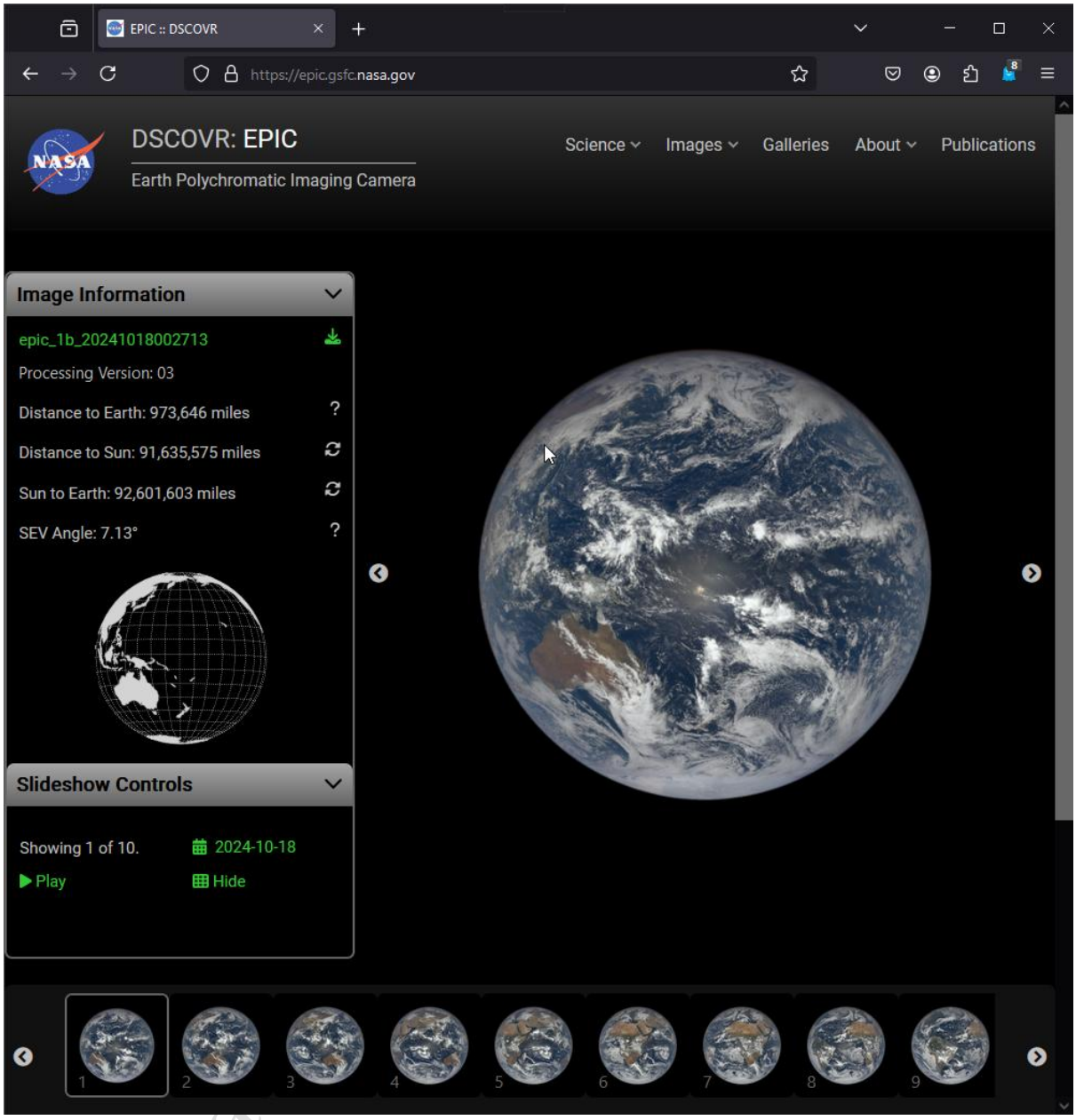


Figure 7 Non-composite photo of Earth from Apollo 17 (source: NASA)

NASA also has a website with a non-composite photo of Earth taken every two hours from their geostationary satellite DSCOVR and its EPIC (Earth Polychromatic Imaging Camera):

https://epic.gsfc.nasa.gov



So far we have seen 7 non-composite "real-time" photos, some of which have no color processing, from 7 independent space agencies with their own launchers and having launched their own independent satellites, which prove that the Earth is a globe. Therefore flattards are manipulators and liars !

Or here is a photo of an original Apollo 12 negative which is therefore not modified nor modifiable and is therefore an original photo:

Taken from:

https://www.rrauction.com/auctions/lot-detail/343031505882221-apollo-11-and-12-original-vintage-negative-and-transparency-collection/

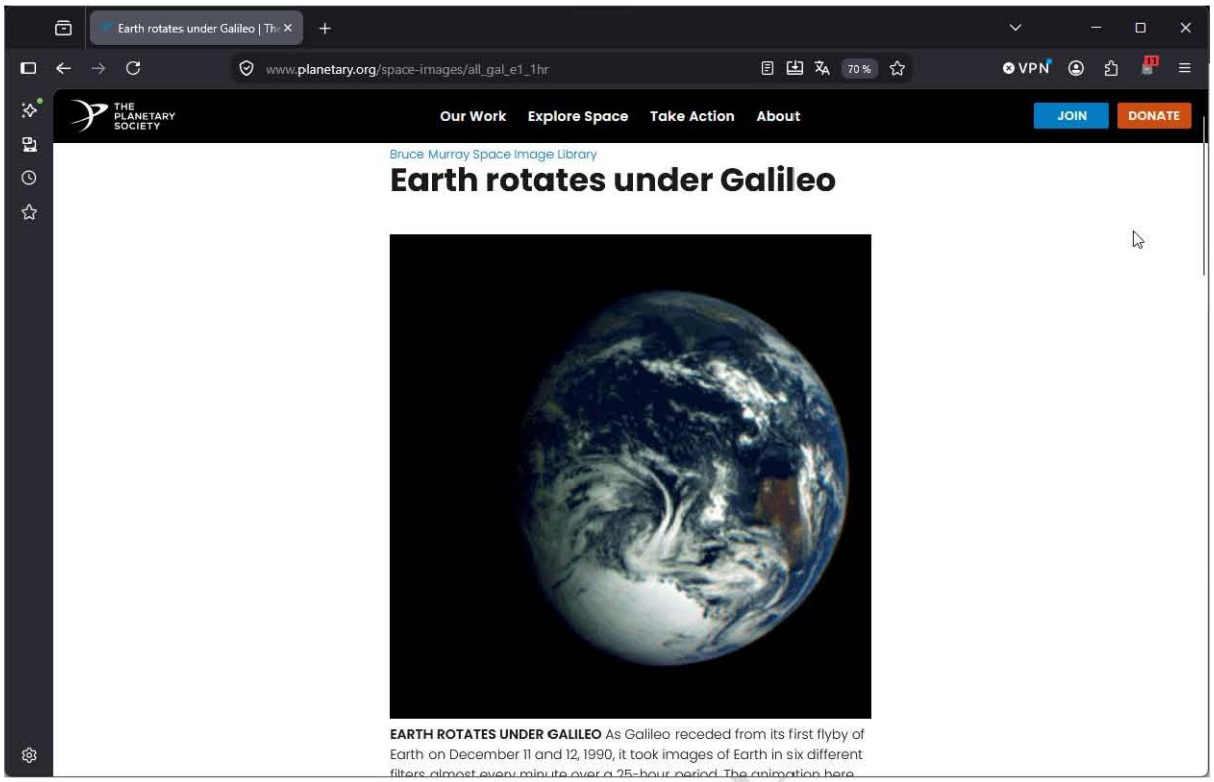
There are also plenty of Apollo 12 negative scans here:

https://tothemoon.im-ldi.com/gallery/Apollo/12/6

And for the pleasure here is an almost 25 hours timelapse of the Earth take by Galileo between December 11 and 12, 1990 (it took images of Earth in six different filters almost every minute)

https://www.planetary.org/space-images/all_gal_e1_1hr

translation int


Earth rotates under Galileo | The
www.planetary.org/space-images/all_gal_e1_1hr
70 %
VPN
THE PLANETARY SOCIETY
Our Work
Explore Space
Take Action
About
JOIN
DONATE
Bruce Murray Space Image Library
Earth rotates under Galileo
EARTH ROTATES UNDER GALILEO As Galileo receded from its first flyby of Earth on December 11 and 12, 1990, it took images of Earth in six different filters almost every minute over a 25-hour period. The animation here

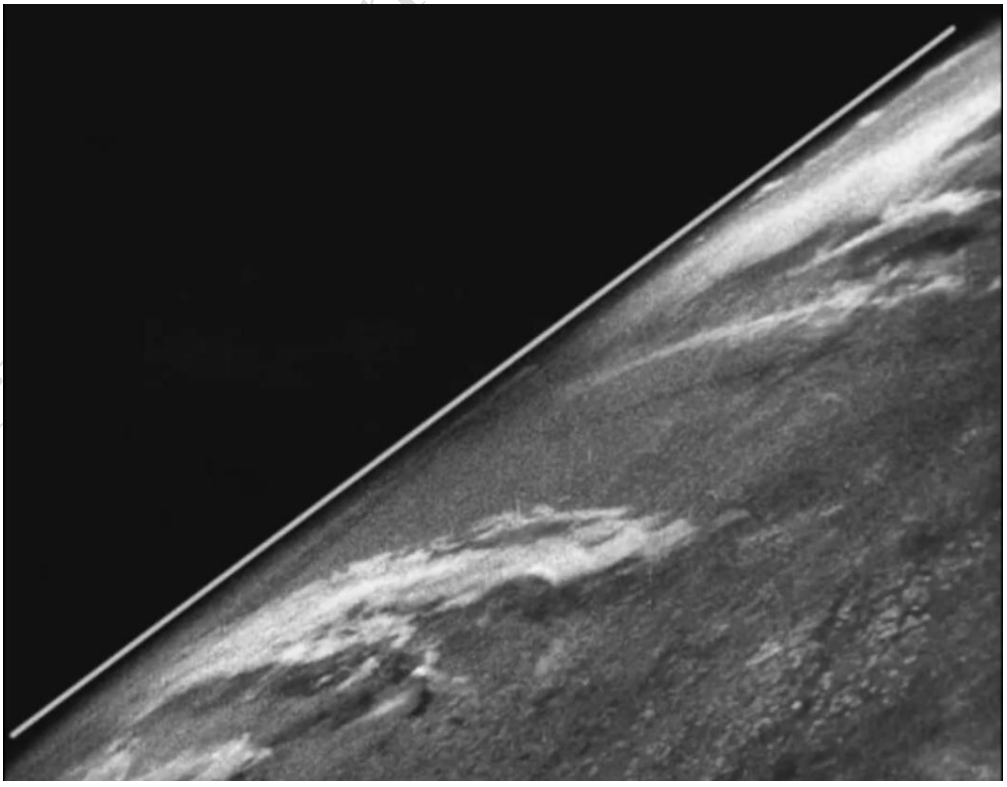
translation into engl

(#008) Non-composite photos of General Motors' V-2 n°13

The V-2 No. 13 was a modified V-2 rocket that became the first object to take a photograph of Earth from space.

Launched on October 24, 1946, at the White Sands firing range in White Sands, New Mexico (U.S.A.), the rocket reached a maximum altitude of 105 km.

The famous photo that shows the curvature of the Earth:



was taken with an attached 35mm DeVry black and white film camera. The flight was an addition to the Hermes program, which had been underway since 1944. The V-2 No. 13 rocket was assembled and launched by General Electric using captured German and remanufactured components.

The full video can be found here:

https://upload.wikimedia.org/wikipedia/commons/transcoded/0/09/1946-11-21_White_Sands_NM_V-2_rocket.ogg/1946-11-21_White_Sands_NM_V-2_rocket.ogg.480p.vp9.webm

translation into english ongoing

Panoramas

On a completely flat Earth, it would be possible to observe very distant locations even taking into account the scattering/absorption of light. However, this has never been done because the Earth is curved (Distance of the Visible Horizon, 1913). If the Earth were flat, the following places should also be visible from each other every day, however this is not the case: Guilvinec (France)-Foz (Spain)/ ~524 kilometers, Marseille (France)-Perpignan (France)/ ~213kilometers, Calvi (France)-Nice (France)/ ~175 kilometers, Chicago (USA)-Manistique (USA)/~464 kilometers, Sevastopol (Russia)-Burgas (Bulgaria)/ ~538 kilometers, Bangkok (Thailand)-Koh Samui (Thailand)/ ~469 kilometers, Sharm El Sheikh (Egypt)-Assab (Eritrea)/ ~1,870 kilometers... among millions of other places in the world where the flat Earth model does not work[4]!

The diffusion/absorption of light by the atmosphere is given as a reminder by the Beer-Lambert law (Opera Magistris, 2024):

$$I = I_0 e^{-\tau}$$

With the optical depth given by:

$$\tau = \int_0^R \alpha(x)\mathrm{d}x$$

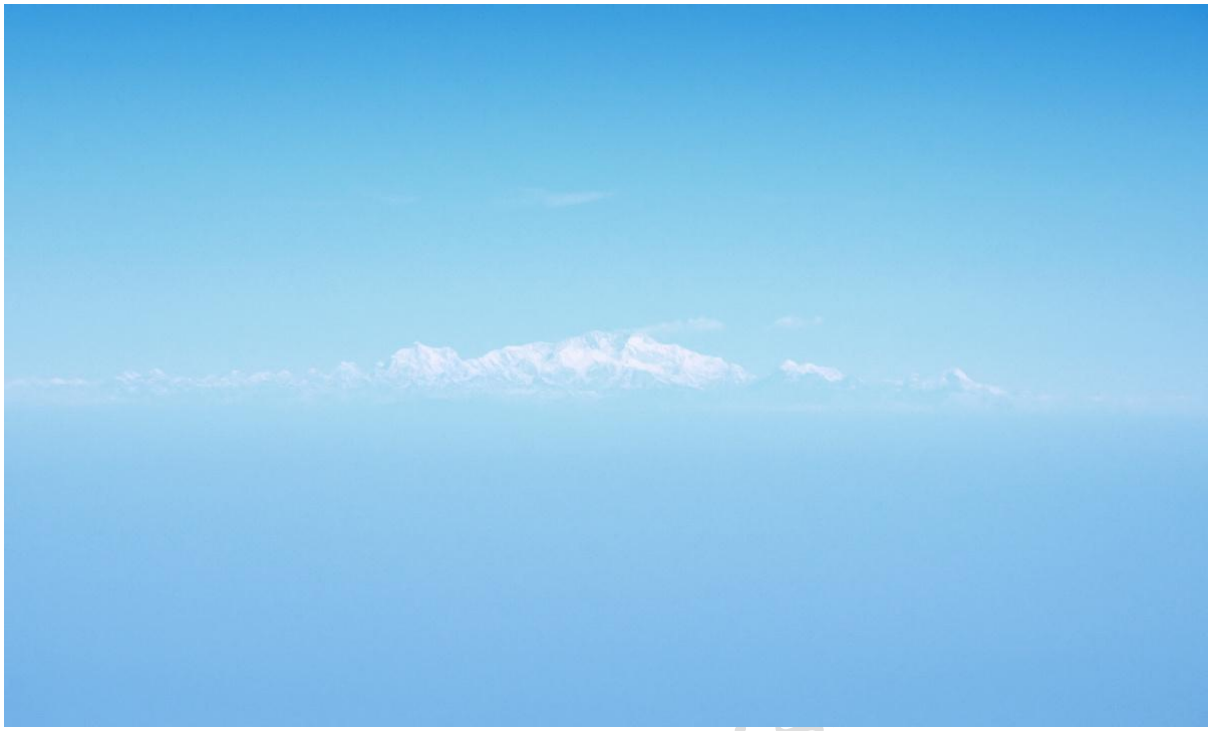
where α is the scattering coefficient which is about 10^{-5} for visible light at position x. Applying this law to visible light over a distance of 500 kilometers gives an attenuation of 99.9999998% (this is more than enough for modern telescope sensors). To reach the limits of the quantum efficiency of modern sensors, it would be necessary to place a visible light source (typically a LASER with a peak power of 1 MW) at a distance of about 2,000 kilometers in the presence of an atmosphere at typical sea level!

So modern optical sensors have a quantum efficiency that largely allows the detection of light over several thousand kilometers of atmospheric distance.

Here for example is what would appear to be one of the world records for photographic distance (Mount Kangchenjunga seen from above Kolkata at a distance of 522 km) from 8,586 kilometers away (in the atmosphere):

translation into english ongoing

[4] The longest photographed line of sight on Earth measures 443 km, taken by Mark Bret Gumá (Spain), from Pic de Finestrelles, Spain, to Pic Gaspard, France, on July 13, 2016. No flat-earther has managed to take a photo of a distant object more than 500 km away because the Earth is curved, not flat.



Let's look at some simple, practical, illustrated cases where flat Earth proponents have failed miserably to demonstrate their model (obviously the list is not exhaustive because there are billions of observation locations that cause the flat Earth model to fail) and are careful not to talk about their failures!

Note: Contrary to an urban legend unfortunately widespread in the non-academic postgraduate world, the absence of proof (or more formally named “the proof of the null hypothesis”) is a form of scientific evidence used regularly in cutting-edge science! The NHST statistical method relating to it is named “the T.O.S.T. method” and is demonstrated and explained in detail in (Opera Magistris, 2024).

translation into englis

(#009) Manistique Lighthouse (USA) to Chicago (USA)/465 km

Here is a view of the Manistique Lighthouse (USA, 45°56’34.34"N, 86°14’54.28"W) towards Chicago (41°53’37.39"N, 87°36’24.16"W) where we cannot see the Chicago coast because it is impossible, it is below the horizon:

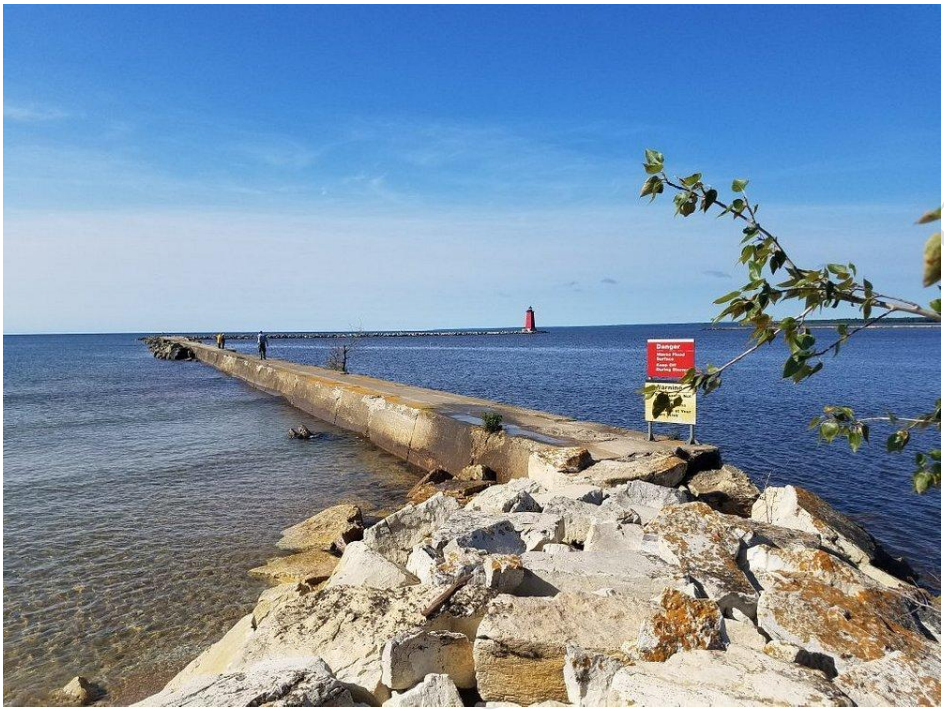
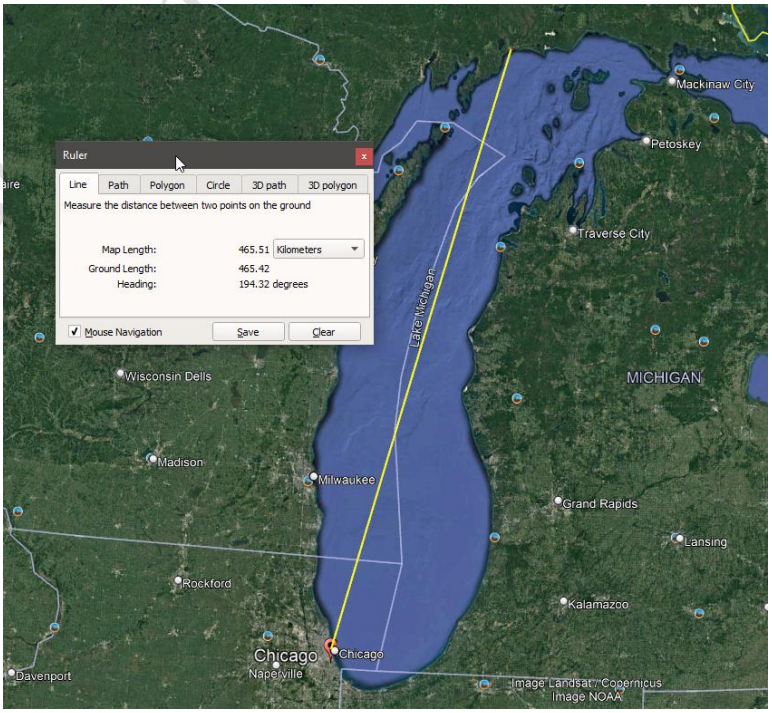


Figure 8 Observation of Chicago from the Manistique lighthouse has not been possible to date (August 2018, author: frtliner)

The distance and contextualization between Chicago (USA) and Manistique (USA) is illustrated below (465 km):

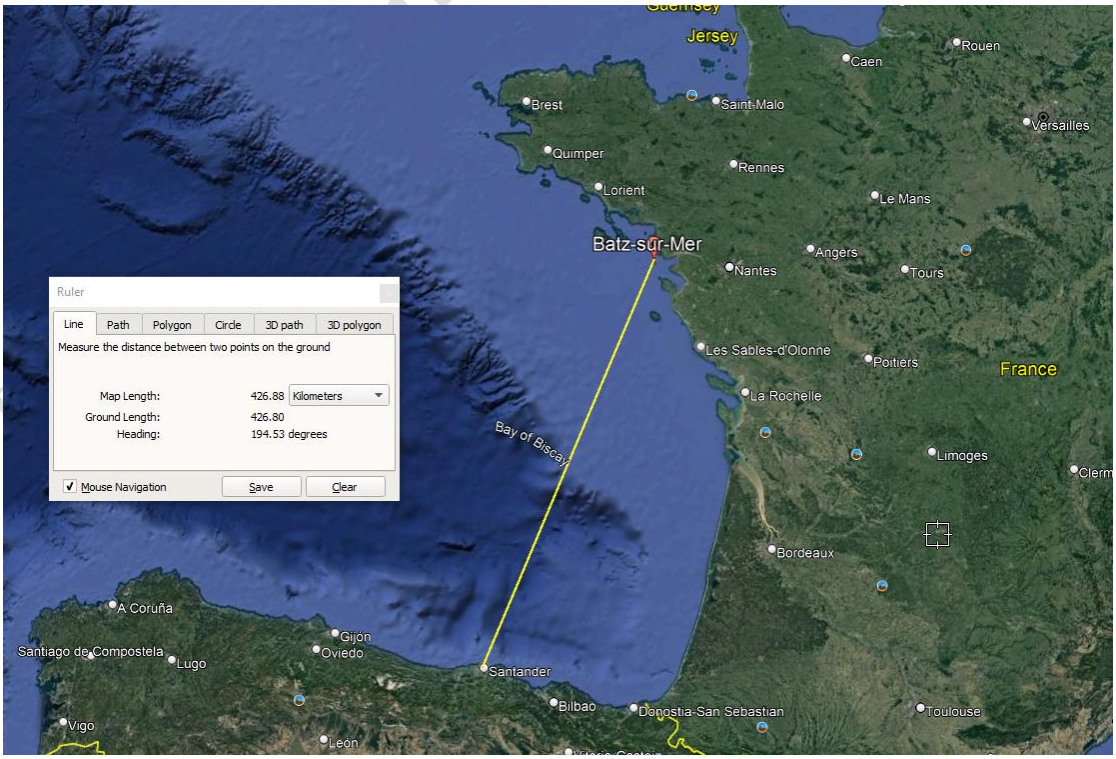


(#010) Baie du Dervin Sea (FRA) to Santander (SPA)/426 km

Here is another viewpoint in Batz on Baie du Dervin Sea/Grand blockhaus (France, 47°16’12.62"N, 2°28’9.03"W) towards Santander (Spain, 43°21’49.64"N, 3°47’10.87"W) where you cannot see the coast of Spain because it is impossible, it is below the horizon:

Figure 9 Dervin Bay Sea / Grand Blockhouse (author: Didier Desroches, source: Google Earth)

The distance and contextualization between the Baie du Dervin Sea (FRA) and Santander (SPA) is illustrated below (426 km):



(#011) Rousse Island/Corsica (FRA) to Toulon (FRA)/274.13 km

Another viewpoint from the cliff of Ile Rousse in Corsica at 64 meters high (France, (42.644775N, 8.931051E) towards Toulon (43°5’57.69"N, 5°56’29.82"E) where you cannot see the coast of Toulon because it is impossible, it is below the horizon:

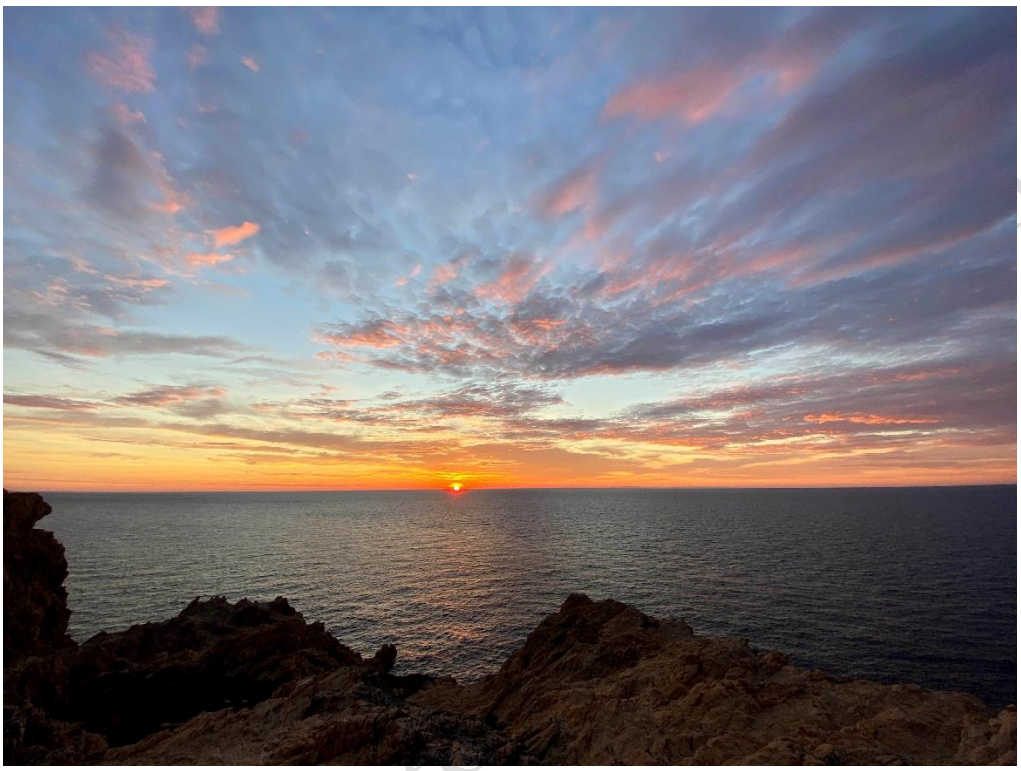
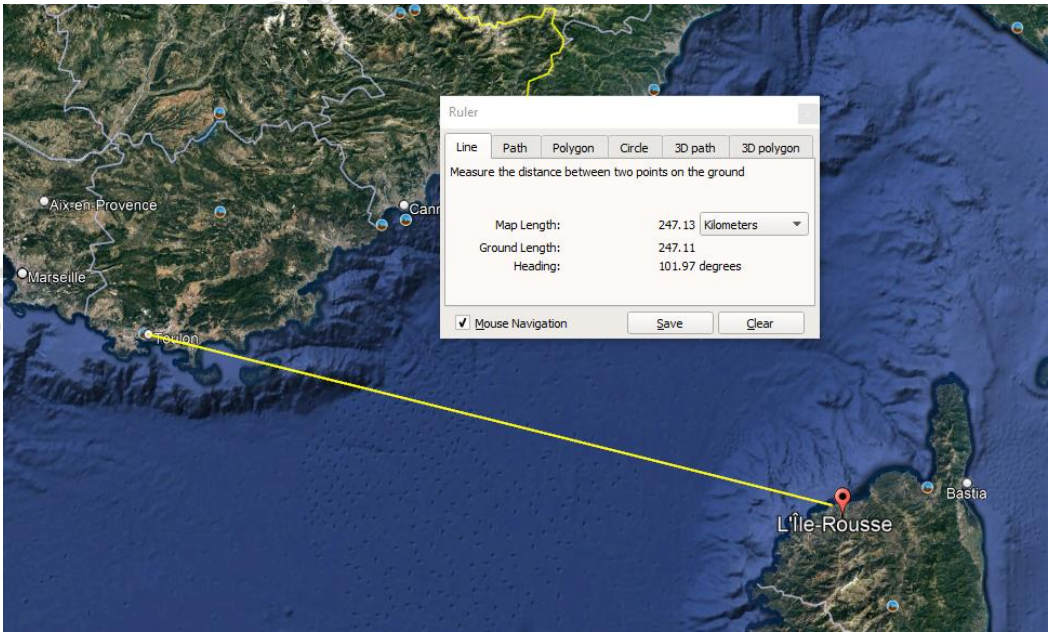


Figure 10 Photos depuis les falaises de l’île Rousse/Corsica (auteur : Laulau.2a)

The distance and contextualization between Ile Rousse (FRA) and Toulon (SPA) is illustrated below (274.13 kilometers):



(#012) Vevey (CHE) to Gland (CHE)/49.36 km

Yet another viewpoint from almost the water level at the beach of Gland (Switzerland, 46°24’54.67"N/6°17’17.33"E):

to Chillon Castle at the level of the foundations (Switzerland, 46°24’51.12"N, 6°55’38.82"E):

there are 49.36 kilometers as contextualized here:

However no flat Earth supporter has ever managed to produce a video or a photo authenticated as unretouched where from the water level of the Gland beach we see the stone foundations of the Chillon castle (and vice versa... no photo has ever been produced and certified as unretouched where we see Gland beach from the water level of the Chillon Castle foundations). Which is an obvious proof that the Earth is not flat because (without refraction) Vevey is about 140 meters below the horizon.

We therefore cannot see the bottom of Gland beach from the water level of Chillon Castle:

Figure 11 Chillon Castle (© Swiss-Image.ch, Sébastien Staube)

(#013) Rolle (CHE) to Thonon (CHE)/13.887 km

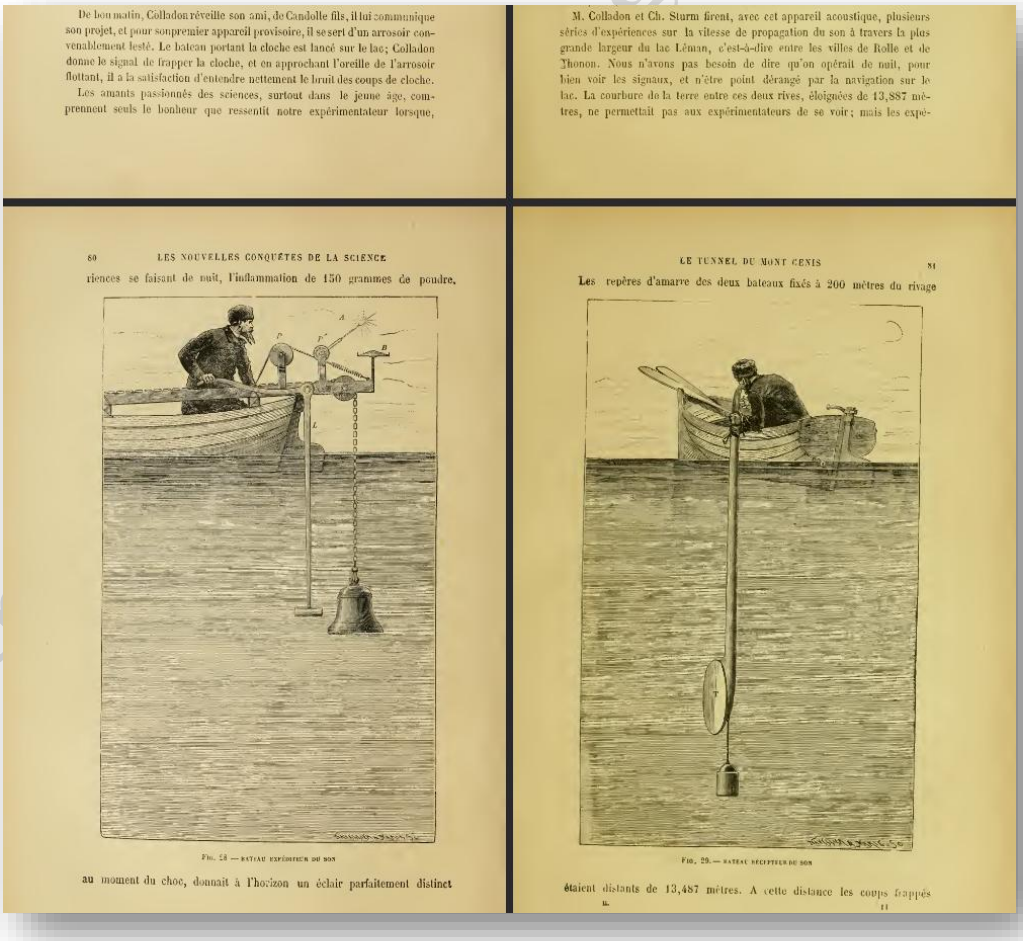
The experiment of Jean-Daniel Colladon, a 19th-century Swiss physicist, provided fascinating evidence of the Earth's curvature. In 1826, Colladon conducted a famous experiment in collaboration with his colleague Charles Sturm. They measured the speed of sound in the water of Lake Geneva, across a distance of approximately 14 kilometers.

Their method involved using two boats located this distance apart. Colladon struck a bell underwater, and the flash produced by the hammer striking the bell started a stopwatch. When the sound reached the other boat, the stopwatch stopped. They were able to calculate the speed of sound in water from the measured time difference.

This experiment not only made it possible to determine the speed of sound in water with great precision, but also to demonstrate the curvature of the Earth. Indeed, the direct line between the two boats, below the surface of the water, could not be observed above the water due to the curvature of the Earth. This small but significant deviation was indirect but convincing proof that the Earth's surface is curved and not flat.

The experience is recounted in the book *Les nouvelles conquêtes de la science* (The new conquests of science) by Louis Figuier printed in 1883 on pages 79-81 available online here:

https://ia801603.us.archive.org/20/items/lesnouvellesconq02figu/lesnouvellesconq02figu.pdf



De bon matin, Colladon réveille son ami, de Candolle fils, il lui communique son projet, et pour son premier appareil provisoire, il se sert d'un arrosoir convenablement lesté. Le bateau portant la cloche est lancé sur le lac; Colladon donne le signal de frapper la cloche, et en approchant l'oreille de l'arrosoir flottant, il a la satisfaction d'entendre nettement le bruit des coups de cloche.

Les amants passionnés des sciences, surtout dans le jeune âge, comprennent seuls le bonheur que ressentit notre expérimentateur lorsque,

M. Colladon et Ch. Sturm firent, avec cet appareil acoustique, plusieurs séries d'expériences sur la vitesse de propagation du son à travers la plus grande largeur du lac Léman, c'est-à-dire entre les villes de Rolle et de Thonon. Nous n'avons pas besoin de dire qu'on opérait de nuit, pour bien voir les signaux, et n'être point dérangé par la navigation sur le lac. La courbure de la terre entre ces deux rives, éloignées de 13,887 mètres, ne permettait pas aux expérimentateurs de se voir; mais les expé-

80 LES NOUVELLES CONQUÊTES DE LA SCIENCE

riences se faisant de nuit, l'inflammation de 150 grammes de poudre,

Fig. 28. — BATEAU EXPÉDITEUR DU SON

au moment du choc, donnait à l'horizon un éclair parfaitement distinct

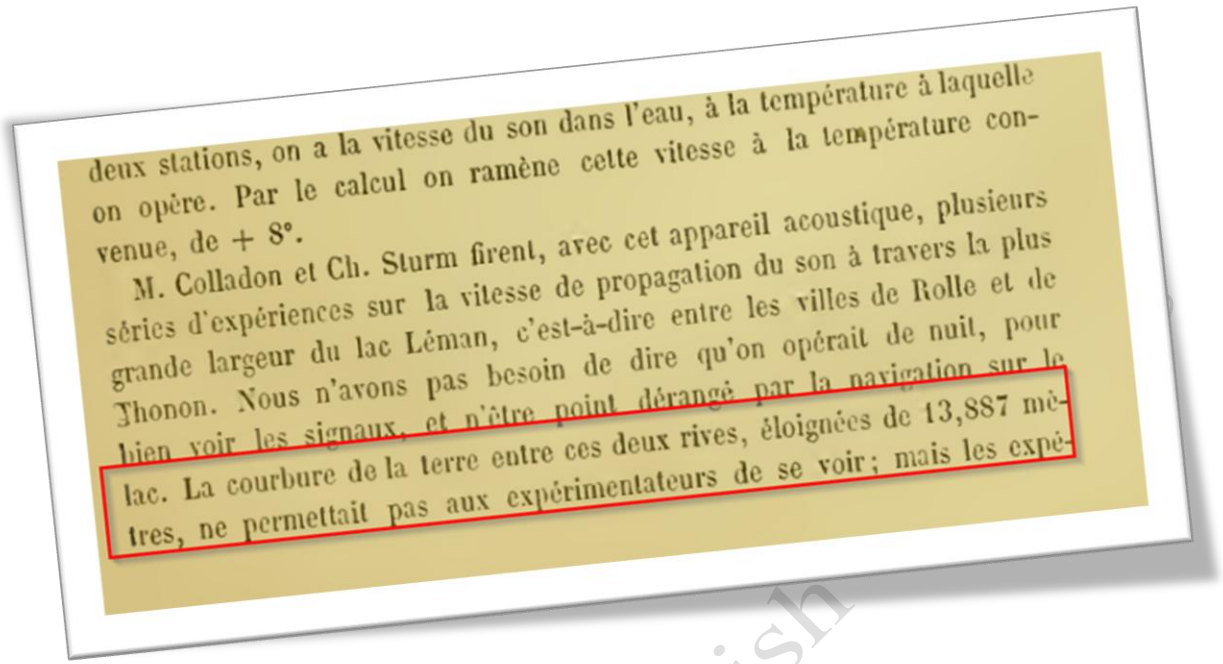
LE TUNNEL DU MONT CENIS 81

Les repères d'amarre des deux bateaux fixés à 200 mètres du rivage

Fig. 29. — BATEAU RÉCEPTEUR DU SON

étaient distants de 13,487 mètres. A cette distance les coups frappés

Or if we zoom in on the part on the interesting part:



deux stations, on a la vitesse du son dans l'eau, à la température à laquelle on opère. Par le calcul on ramène cette vitesse à la température convenue, de + 8°.

M. Colladon et Ch. Sturm firent, avec cet appareil acoustique, plusieurs séries d'expériences sur la vitesse de propagation du son à travers la plus grande largeur du lac Léman, c'est-à-dire entre les villes de Rolle et de Thonon. Nous n'avons pas besoin de dire qu'on opérait de nuit, pour bien voir les signaux, et n'être point dérangé par la navigation sur le lac. La courbure de la terre entre ces deux rives, éloignées de 13,887 mètres, ne permettait pas aux expérimentateurs de se voir; mais les expé-

Here is the translation into English: “The curvature of the Earth between these two banks, 13,778 meters apart, did not allow the experimenters to see each other.”

So here we have another empirical, reproducible and verifiable proof on a calm body of water that the Earth is not flat!

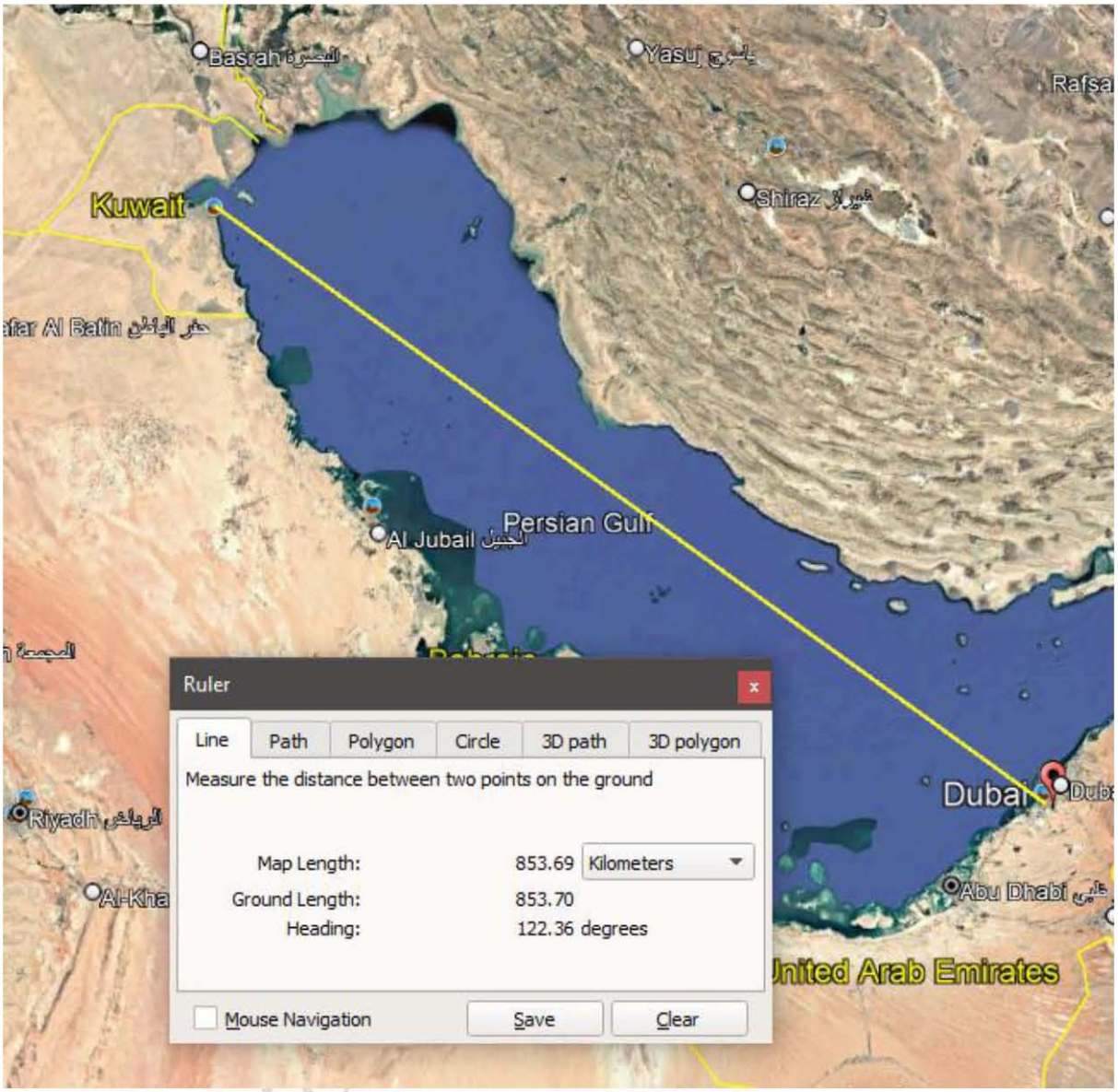
translation into english

(#014) Dubaï/Burj-Khalifa (EAU) to Koweït (IRA)/853 km

From the towers of Kuwait (Iraq):

No flattard has managed to take a picture of the Burj Khalifa tower in Dubai (United Arab Emirates) with a telescope or telephoto lens from the Kuwait Towers, and vice versa:

This is proof that these buildings are below the horizon and that therefore Earth isn't flat!


Basrah
Yasuj
Rafsa
Kuwait
Shiraz
Persian Gulf
Al Jubail
Ruler
Line
Path
Polygon
Circle
3D path
3D polygon
Measure the distance between two points on the ground
Map Length:
853.69
Kilometers
Ground Length:
853.70
Heading:
122.36 degrees
Mouse Navigation
Save
Clear
Riyadh
Dubai
Abu Dhabi
United Arab Emirates

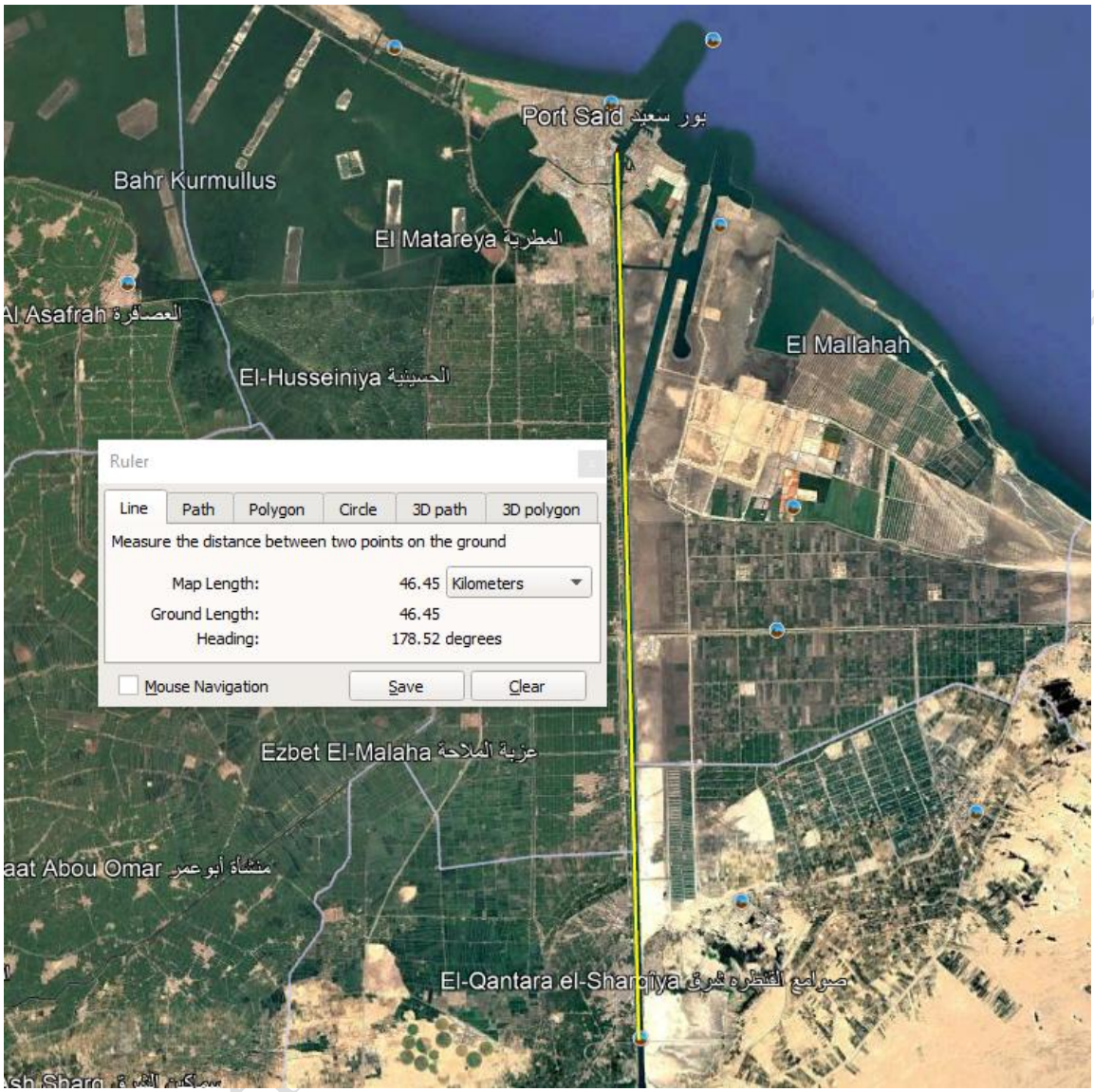
translatie

(#015) Alam Salam Bridge (EGY) to Port Saïd (EGY)/46.45 km

Between the Al Salam bridge in Egypt on the Suez Canal:

and the docks of Port Said (31°12’34.81"N, 32°18’12.27"E):

There are 46.45 kilometers:

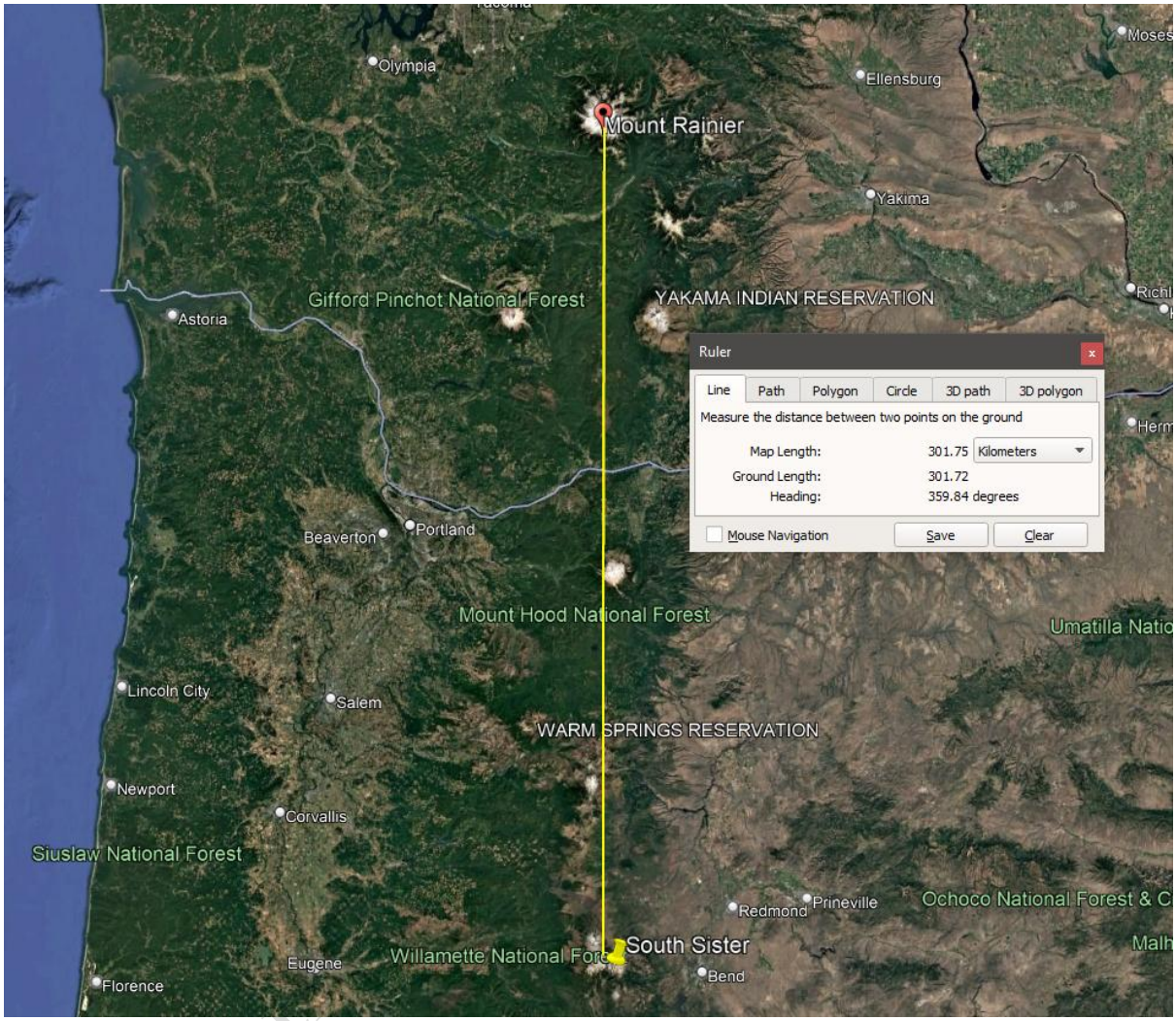


Yet no flat Earth supporter has ever managed to produce a video or a photo authenticated as unretouched or from the water level of the banks of Port Said where we see the foundations of the Alam Salam Bridge (and vice versa...). Which is an obvious proof that the Earth is not flat.

translation

(#016) Mont South Sister (USA) to Mont Rainier (USA)/300 km

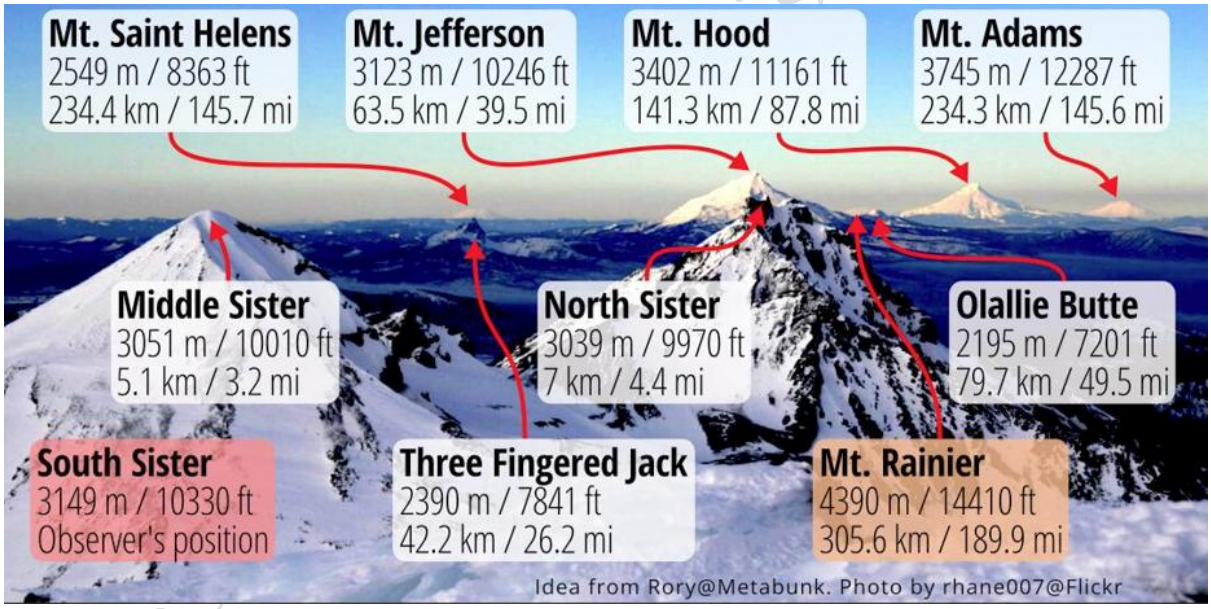
There is a distance of just over 300 kilometers between Mount South Sister (Oregon) and Mount Rainier (Washington) in the USA!



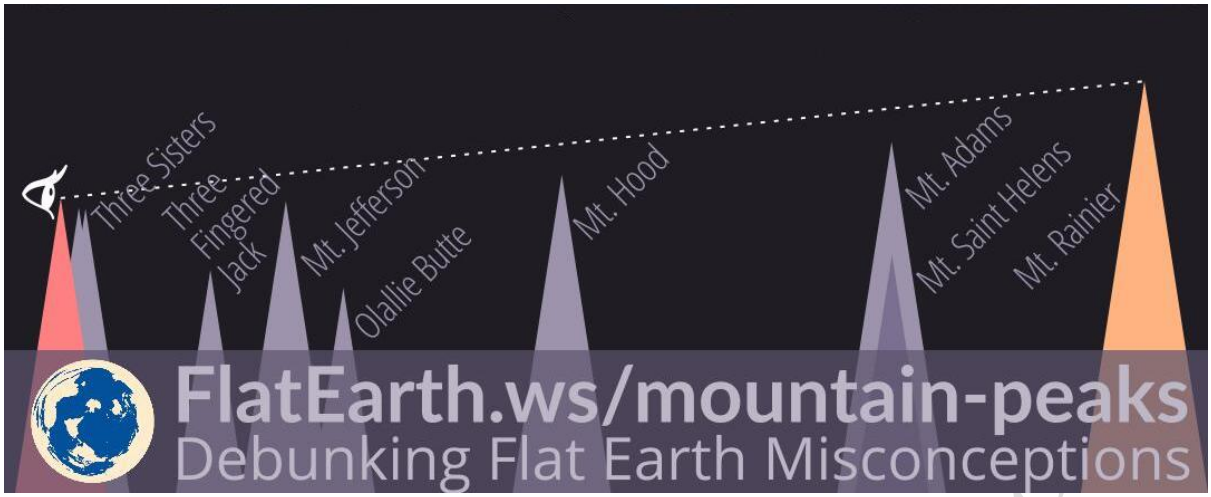
Now from Mount Sister, here is the photo taken by @rhane007:

translation

With the legends and distances this gives:


Mt. Saint Helens
2549 m / 8363 ft
234.4 km / 145.7 mi
Mt. Jefferson
3123 m / 10246 ft
63.5 km / 39.5 mi
Mt. Hood
3402 m / 11161 ft
141.3 km / 87.8 mi
Mt. Adams
3745 m / 12287 ft
234.3 km / 145.6 mi
Middle Sister
3051 m / 10010 ft
5.1 km / 3.2 mi
North Sister
3039 m / 9970 ft
7 km / 4.4 mi
Olallie Butte
2195 m / 7201 ft
79.7 km / 49.5 mi
South Sister
3149 m / 10330 ft
Observer's position
Three Fingered Jack
2390 m / 7841 ft
42.2 km / 26.2 mi
Mt. Rainier
4390 m / 14410 ft
305.6 km / 189.9 mi
Idea from Rory@Metabunk. Photo by rhane007@Flickr

Now if the Earth were flat, Mount Rainier should clearly appear above the other mountains:



but in reality this is not the case because the Earth is not flat!

translation into english ongo

(#017) Shape of planetary bodies and moons

All Earth-sized bodies in the solar system (and even smaller and larger ones) observed by space telescopes like Hubble, the James Webb telescope, and other ground-based telescopes (professional or amateur) are observed to be geoids (like the Moon, Mars, Mercury, Venus, Uranus, Ganymede, Callisto, Io, Europa, etc.). It is abductive statistical evidence that the likelihood that the Earth is globally flat is low… very low!

For more information see: (Size and shape of a celestial body, definition of a planet, 2018) et (The Shape of Celestial Objects, 2016).

The relations of abductive statistics are given as a reminder by the following Bayesian relations (Bayesian inference for statistical abduction using Markov chain Monte Carlo, 2011) :

$$p(\theta|\alpha) = \prod_{j=1}^{M} p(\theta_j|\alpha_{kj})$$

With :

$$p(\theta_j|\alpha_{kj}) = \frac{1}{Z(\alpha_{kj})} \prod_{v=1}^{M_j} \theta_{jv}^{\alpha_{k_j v}-1}$$

And :

$$Z(\alpha_{kj}) = \frac{\prod_{v=1}^{L_k} \Gamma(\alpha_{kv})}{\Gamma(\sum_{v=1}^{L_k} \alpha_{kv})}$$

Non-Planet of the Solar System to scale
Dwarf Planets (Ceres & Pluto) – Moons of Planets and Dwarf Planets – Asteroids – Comets
THE REPRESENTATION BETWEEN MOONS & PLANET ON DISTANCE LINE AND PLANET & PLANET OF DISTANCE LINE IS NOT TO SCALE

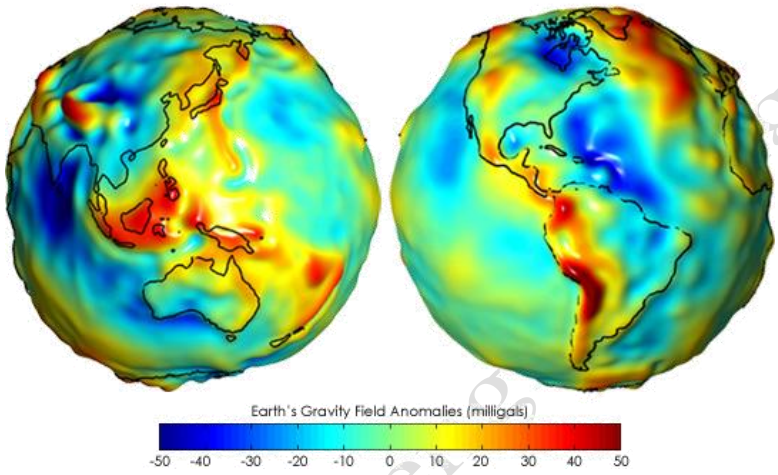
Figure 12 A variety of small bodies in the solar system, to scale (source: Wikipedia/Antonio Ciccolella)

into english ongoing

(#018) Gravimetry

The Earth's gravimetry has been measured on the ground and also by satellite. It is compatible with the Newtonian model (approximation of the Einstein model for low-mass stars in non-relativistic rotation) of a spherical Earth (Opera Magistris, 2024).

Below we can see a restitution of the raw measured data of Earth's gravity by the NASA GRACE mission (2002-2017), showing the deviations - amplified - from the theoretical gravity of a smooth and idealized Earth, called an Earth ellipsoid. Red indicates the areas where gravity is stronger than the standard smooth value, and blue indicates the areas where gravity is weaker:



$$a = G\frac{M}{R^2}$$

Obviously, to defend their model... flattards have no choice but to reject all models of gravity and the existence of gravity itself along with...

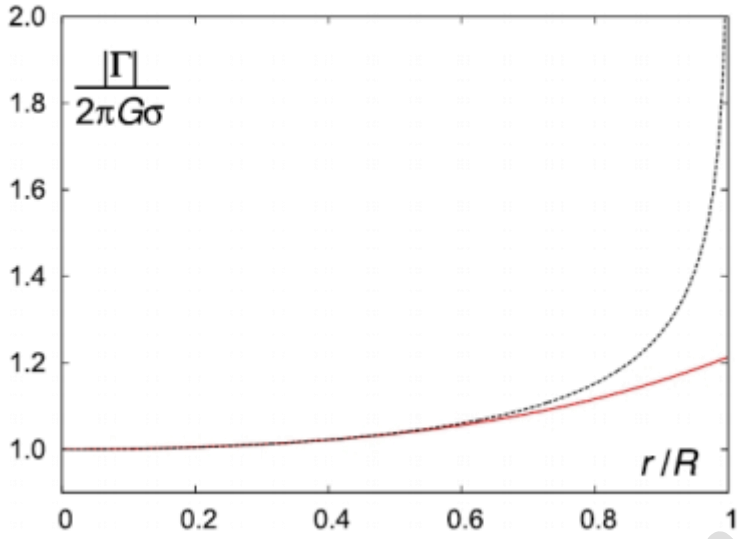
On a flat Earth, the intensity of gravity is proved in (Opera Magistris, 2024) and in (Kuzii, 2019) gives:

$$\Gamma_r = -G\sigma\left(\frac{\pi R^3}{(z^2+R^2)^{3/2}}\frac{r}{R} + \frac{3\pi R^5(R^2-4z^2)}{8(z^2+R^2)^{7/2}}\left(\frac{r}{R}\right)^3 + \cdots\right)$$

where σ is the surface density of the flat Earth.

Below is the plot of the magnitude of the gravitational field strength at the surface ($z = 0$) where the red solid line corresponds to the calculations according to the series expansions while the black dotted line is the exact result:

translation into e.g. ongoing



The conclusion of the reality of a flat Earth can be illustrated by:

This goes without saying...

translation ongoing

(#019) Size of continents/countries/states....

Since flattards communicate the radius of their Earth... it is then possible for us to calculate the size of continents/countries/districts and compare them with reality. And obviously it goes without saying that absolutely nothing corresponds for any of the 5 continents and the little over 200 current countries without counting the tens of thousands of districts!

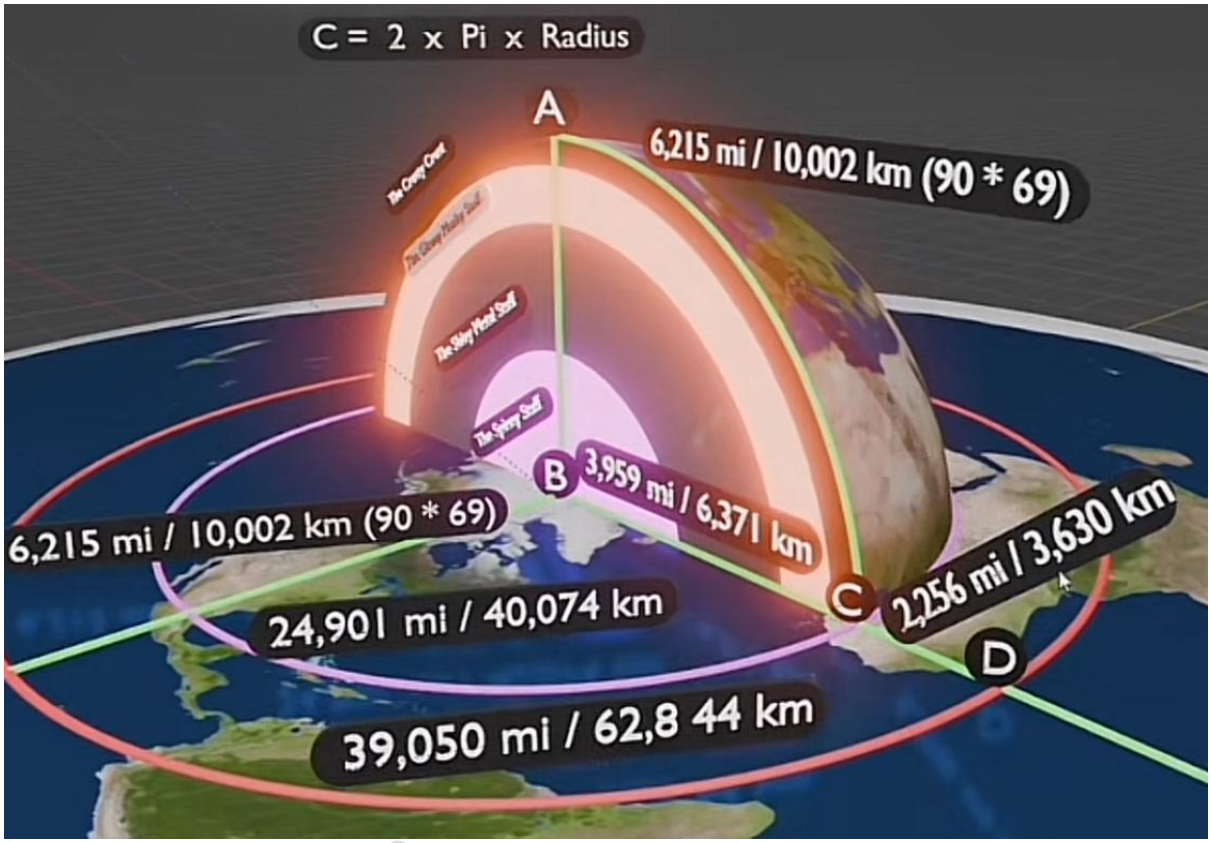
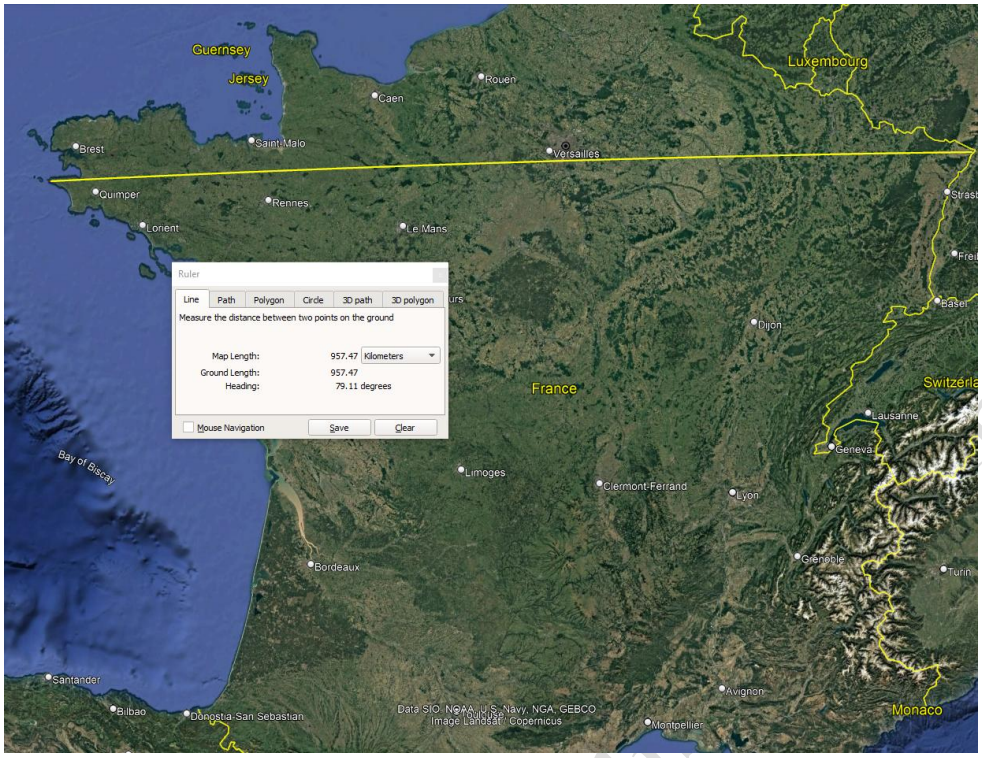


Figure 13 Dimensions of the real oblate vs. imaginary flat Earth (auteur : StingRay)

Let's take France as an example (however the problem occurs for ALL other countries)! We will take the easternmost and westernmost points of France and we get:

translation



With the easternmost point above being 47°55'21.85"N, 4°44'58.66"W and the westernmost point 48°58'12.65"N and 8°14'3.98"E:

http://walter.bislins.ch/bloge/index.asp?page=Distances+on+Globe+and+Flat+Earth

	Latitude			Longitude			→DMS	→Deg	Reset
P1	47 °	55 min	21 sec	4 °	44 min	58 sec			
P2	48 °	58 min	12 sec	8 °	14 min	3 sec			

Computed Distances from P1 to P2			Planet Sizes used for Calculation		
Globe	282.150901	km	RadiusGlobe	6,371	km
Flat Earth	304.143795	km	FE-PoleEquator	10,007.543398	km

Units ◉ km ○ nmi (nautical miles) ○ mi (statute miles)

So on the flat Earth France magically gains about 30 kilometers which came out of nowhere….

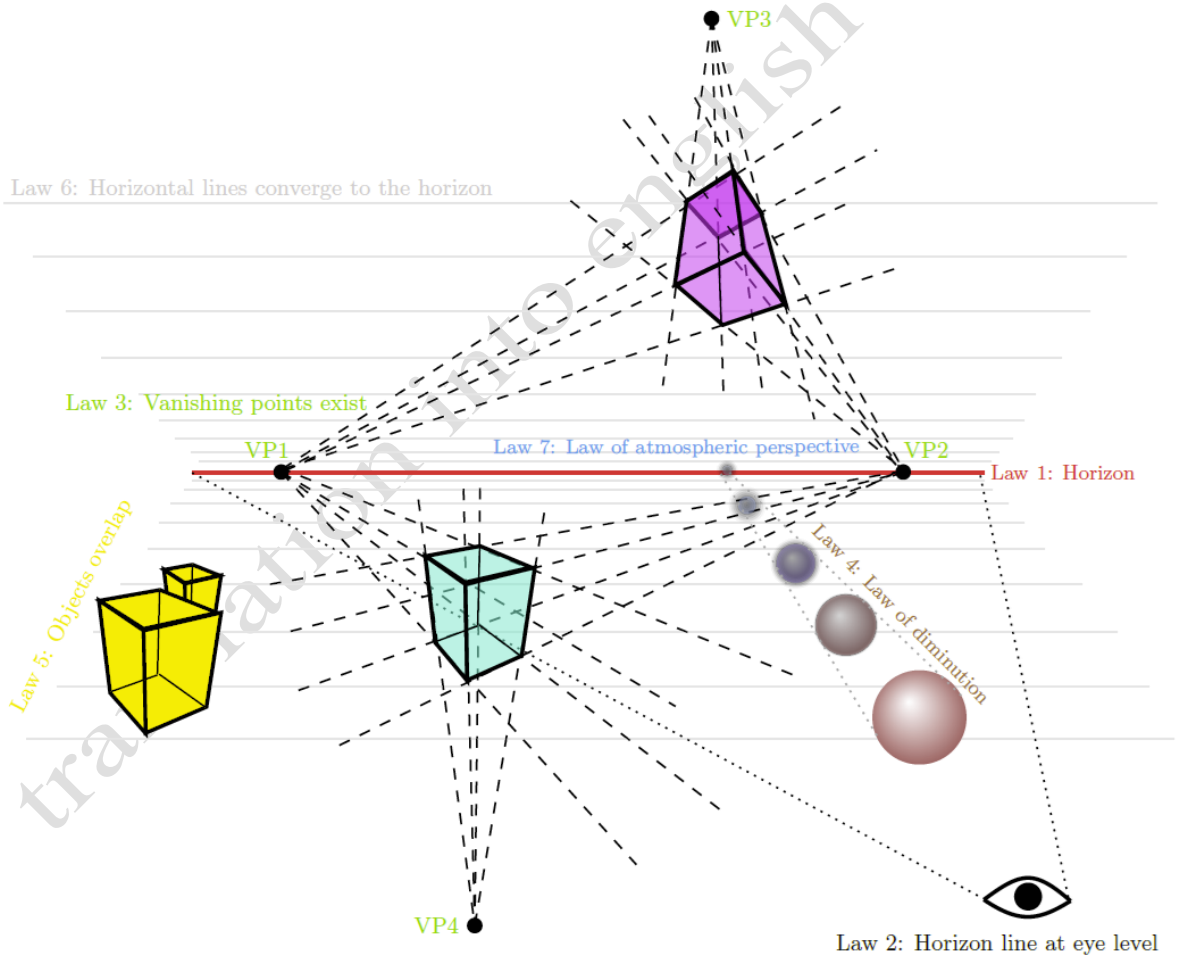
Visual Horizon and Laws of Perspective (Curvature)

From a large sea or lake (more than 50 kilometers wide for example) and a position for example at water level (coast) one cannot see the coast on the other side (Distance of the Visible Horizon, 1913). This implies that ships or offshore wind farms - such as the Thorntonbank wind farm in Belgium - on the horizon disappear from the bottom up and do not shrink uniformly as would be the case according to the law of perspective on a flat Earth (Opera Magistris, 2024). As a reminder, here are the homographic laws of linear perspective (Opera Magistris, 2024):

$$y' = \frac{y\Delta}{z + \Delta}$$

$$x' = \frac{x\Delta}{z + \Delta}$$

And the reminder of the 7 laws of linear perspective in a single illustration:



translation into english ongoing

The distance to the visible horizon taking into account atmospheric conditions is given by the following relationship (Opera Magistris, 2024) where R is the radius of the Earth, h the height of the viewpoint and n the refractive index:

$$d_{\text{curv,refl}} \cong \left[\frac{\cos\left(\arcsin\left(\frac{\sqrt{h^2+2Rh}}{R+h}\right)\right)}{n}\frac{\mathrm{d}n}{\mathrm{d}y}R\sin\left(\frac{\sqrt{h^2+2Rh}}{R+h}\right)\right]R+\frac{\pi R}{180}\arccos\left(\frac{R}{R+h}\right)$$

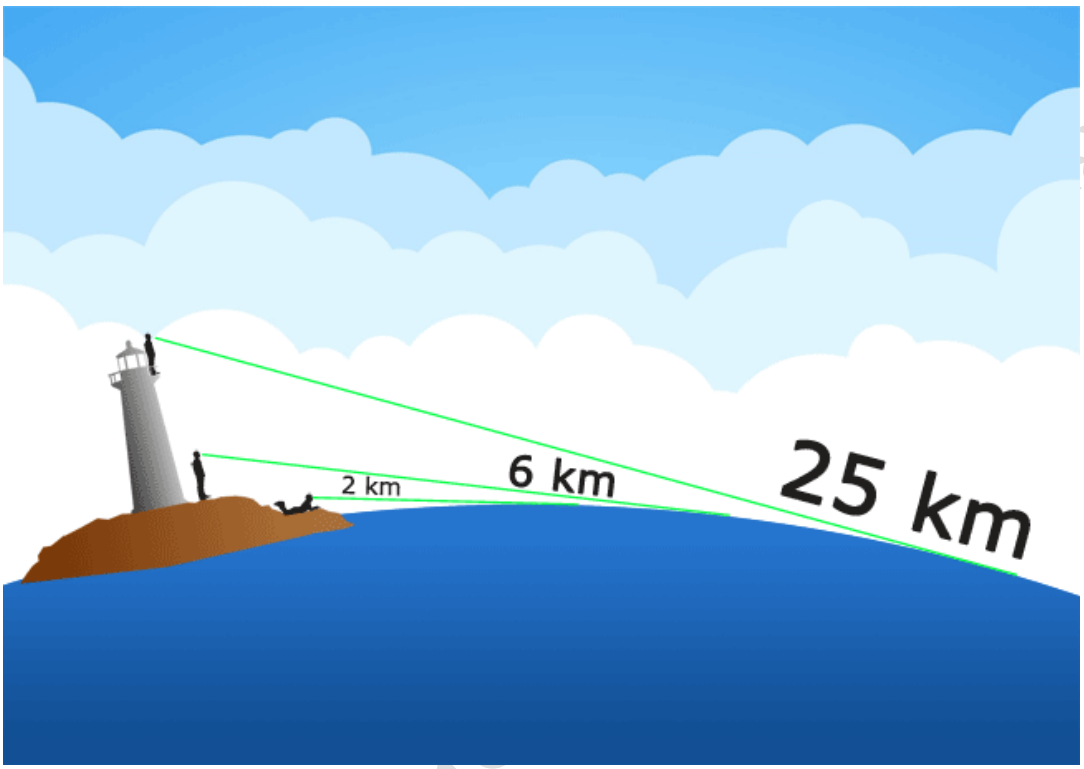
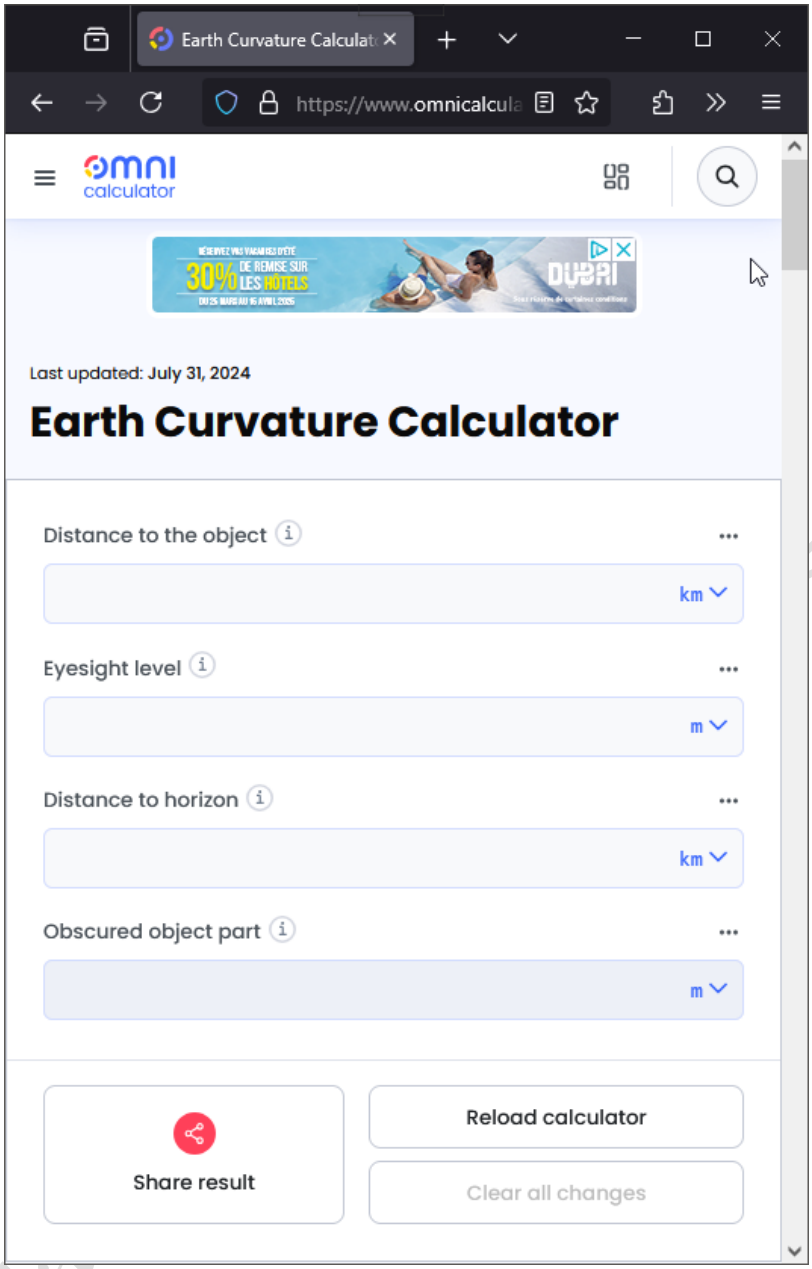


Figure 1 Simple geometric horizon for some heights without taking into account refraction (source : https://www.pirates-corsaires.com)

To calculate the naive geometric horizon (without taking into account refraction) there is an online calculator here:

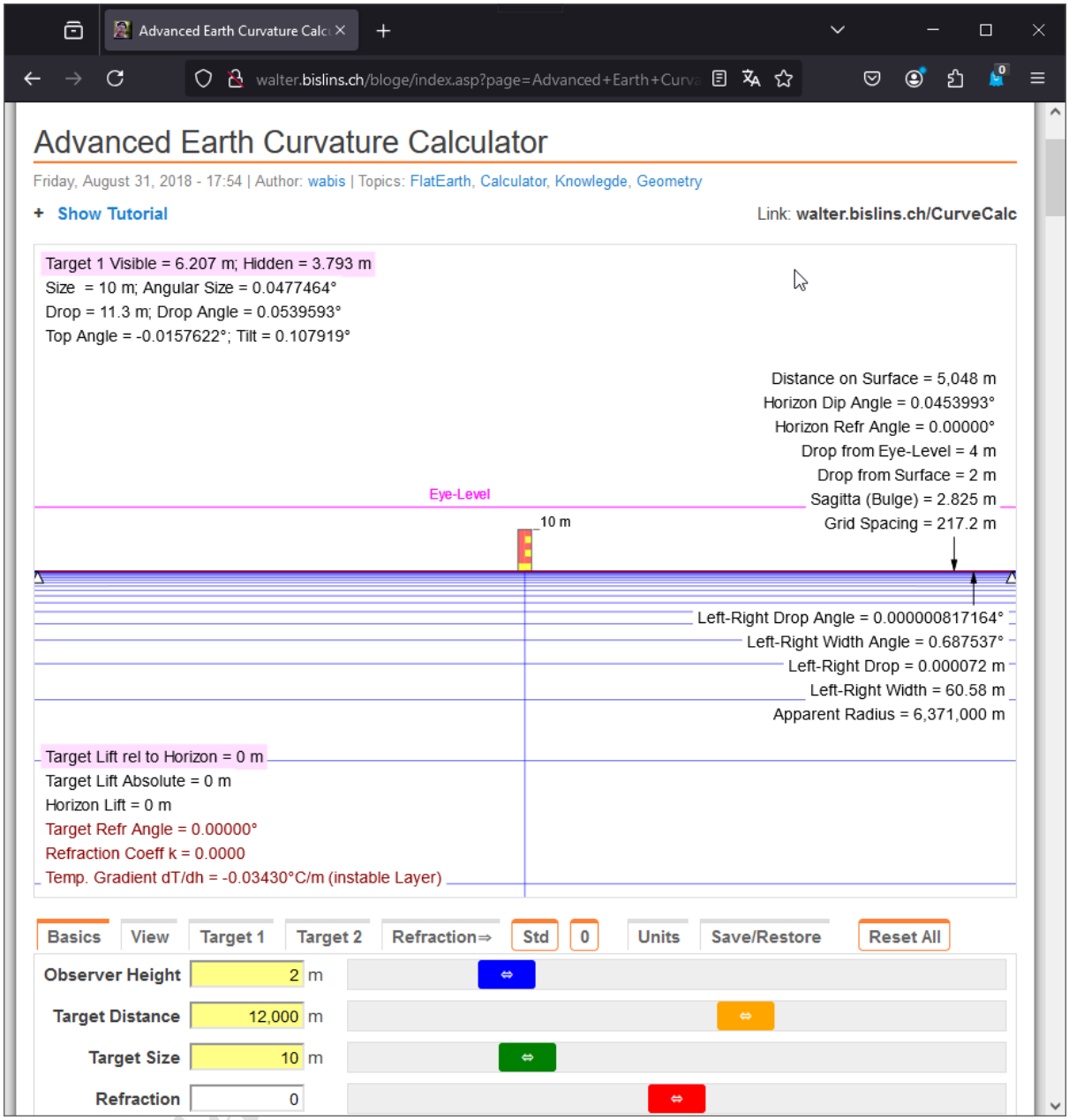
https://www.omnicalculator.com/fr/physique/calculateur-courbure-terre

translation in progress



And to take into account refraction:

http://walter.bislins.ch/bloge/index.asp?page=Advanced+Earth+Curvature+Calculator



where the website page visible above use the famous relationship (see the detailed proof in (Opera Magistris, 2024)) for the hidden height:

$$h_h = \frac{R'}{\cos\left[\frac{s}{R'} - \arccos\left(\frac{R'}{R' + h_0}\right)\right]} - R'$$

with:

$$R' = \frac{R}{1-k}$$

where:

- h_h is the height hidden below the horizon
- d is the curvilinear distance between the two points of interest
- h_0 is the observer's line of sight measured relatively to the surface of the globe
- R' is the effective radius of the Earth
- R is the mean radius of the Earth when considered as a perfect sphere
- k and the refractive coefficient (not to be confused with the refractive index!)

Here is a typical table of some values:

Hidden height h_h [m]	Refractive coefficient k [-]	Temperature gradient ∇ [K/m]	Curvilinear distance s [km]	Height of the observer h_0[m]	Case inspired by
1'113	0.5	0.047	210	68	Nice-Corse
1'393	0.4	0.031	210	68	Nice-Corse
1'679	0.3	0.0145	210	68	Nice-Corse
1'969	0.2	-0.0017	210	68	Nice-Corse
2'264	0.1	-0.018	210	68	Nice-Corse
2'560	0	-0.0343	210	68	Nice-Corse
3.6	0	-0.0343	60	220	Mont Baldy-Chicago
49.05	0.9	0.112	94.2	1.8	Saint Joseph-Chicago
109.4	0.8	0.096	94.2	1.8	Saint Joseph-Chicago
171.9	0.7	0.079	94.2	1.8	Saint Joseph-Chicago
235.6	0.6	0.063	94.2	1.8	Saint Joseph-Chicago
299.9	0.5	0.047	94.2	1.8	Saint Joseph-Chicago
364.8	0.4	0.031	94.2	1.8	Saint Joseph-Chicago
430	0.3	0.0145	94.2	1.8	Saint Joseph-Chicago
495.6	0.2	-0.0017	94.2	1.8	Saint Joseph-Chicago
561.4	0.1	-0.018	94.2	1.8	Saint Joseph-Chicago
627.4	0	-0.0343	94.2	1.8	Saint Joseph-Chicago
1'236	0.5	0.047	256	242	Marseille-Pic du Canigou
1'600	0.4	0.031	256	242	Marseille-Pic du Canigou
1'976	0.3	0.0145	256	242	Marseille-Pic du Canigou
2'362	0.2	-0.0017	256	242	Marseille-Pic du Canigou
2'775	0.1	-0.018	256	242	Marseille-Pic du Canigou

Hidden height h_h [m]	Refractive coefficient k [-]	Temperature gradient ∇ [K/m]	Curvilinear distance s [km]	Height of the observer h_0[m]	Case inspired by
2'954	0.05	-0.026	256	242	Marseille-Pic du Canigou

For a scientific paper on the correction of optical distance measurements for the fluctuating atmospheric index of refraction, see: (Correction of optical distance measurements for the fluctuating atmospheric index of refraction, 1965).

The problem with the flat Earth hypothesis is that it's based on a fundamental contradiction!

Their only real argument is that the horizon appears flat, and therefore the Earth must be. In other words, you have to trust what you see, you have to rely on your senses.

But if you point out to them that you see the Sun setting and not moving away as their model suggests, then suddenly they'll talk to you about perspective and refraction effects—in other words, you shouldn't trust what you see.

So you have to trust your senses, but only when it suits them… LoL

(#020) Corsica from Cagnes-Sur-Mer/Nice (France)

The relationship given above perfectly explains why in some rare atmospheric conditions and for a particular position of the Sun it is possible a few times a year (unlike a flat Earth where it should be possible almost every day!) to see the heights of Corsica (and not the towns on the coast), from the heights of Nice Cagnes-Sur-Mer at an observation height of 78 meters:

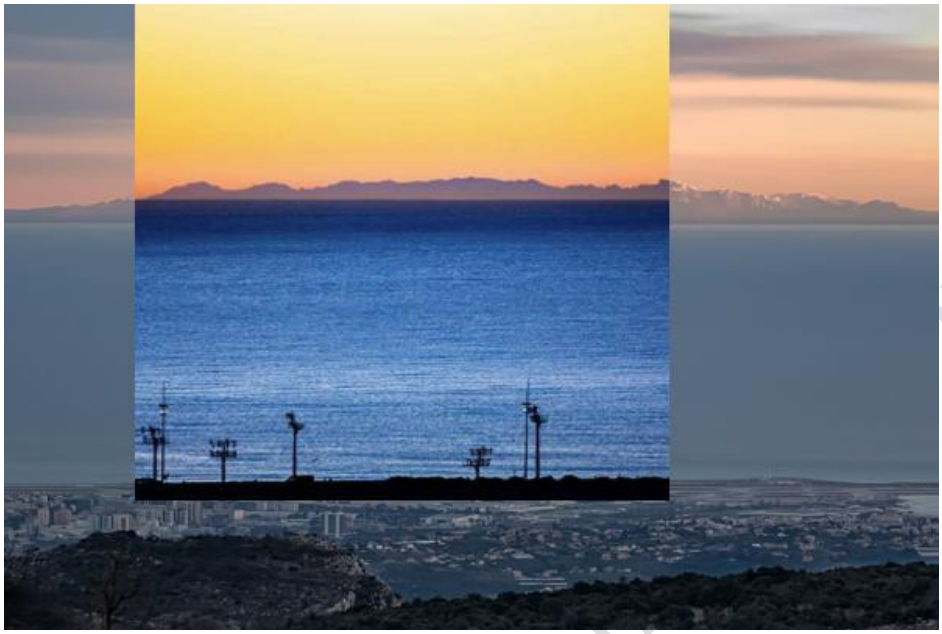
translation into English ongoing

Figure 14 Photo of the heights of Corsica at dawn on Tuesday, January 15, 2019 from Cagnes sur Mer at an altitude of 78 meters (author : John Bouchet, www.johnb.fr)

To compare with this photo taken much higher:

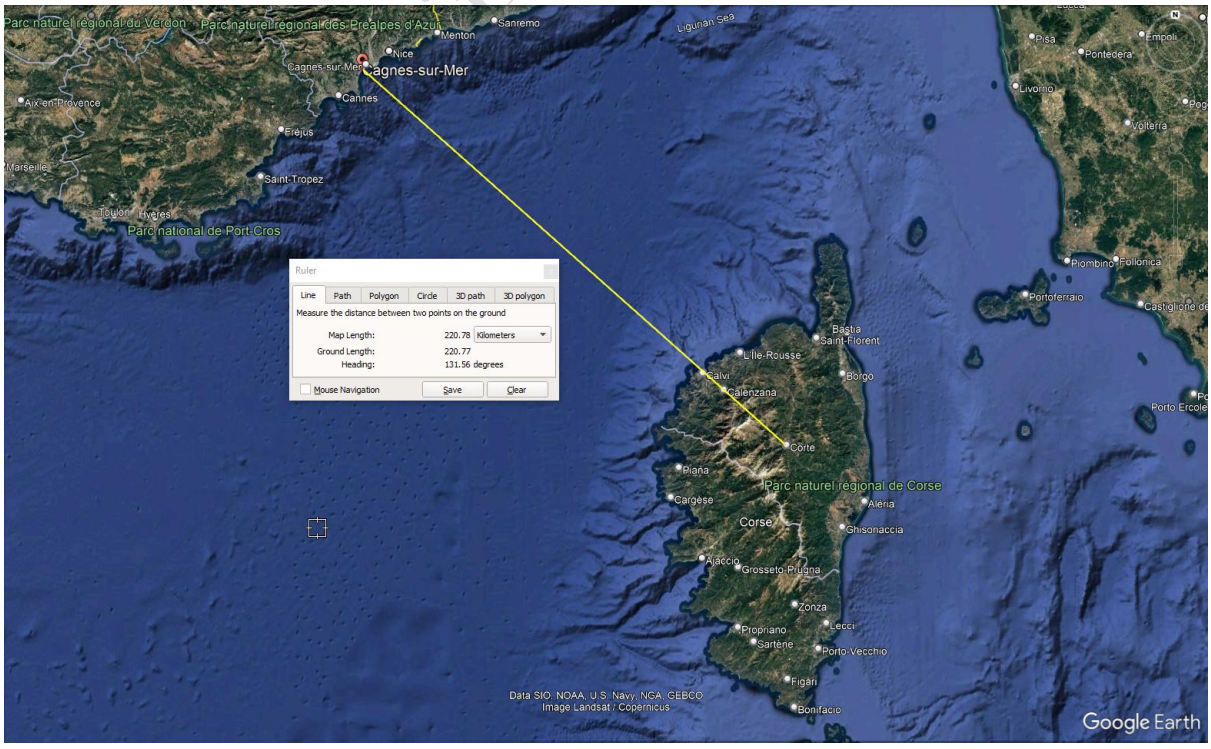
Figure 15 Photo of Corsica from the heights of Nice (author : John Bouchet https://andrieu.photos/corse)

We already see a problem: the photo from Cagnes-sur-Mer contains less than 30% of the height of Corsica (which is obviously inexplicable on a flat Earth model...) as illustrated by this superposition:



So, since the highest peak in Corsica is at 2,706 meters, this means that from Cagnes-sur-Mer there are only about 811 meters visible and 1,844 meters below the horizon of the Earth's curvature.

In terms of distance between Cagnes-sur-Mer and the upper center of Corsica, we have approximately 220 kilometers:



At dawn on that day, here is what the archives of the nearest weather stations we were able to find in terms of proximity to the points of interest gave for weather data:

https://www.infoclimat.fr/observations-meteo/archives/

Nice capteur 07690, LFMN	4 meters 43,65°N | 7,20°E	9h00 at the morning	15 January 2019	6.9 degrees Celsius
Corte (upper Corsica)	470 meters 42,32°N | 9,15°E	9h00 at the morning	15 January 2019	-1.3 degrees Celsius

Heure locale	Température	Temps	Pluie	Vent	Humidité	Bio-météo	Pt. de rosée	Pression
15h	14.8 °C (14.8 → 15.4)	Mer ridée	0 mm/1h	11 km/h raf.18.4	49%	356	4.2 °C	1018.1hPa ↘
14h	15.1 °C (15 → 15.7)	Mer ridée	0 mm/1h	11 km/h raf.11.9	44%	422	2.9 °C	1018.4hPa ↘
13h	15.0 °C (12.9 → 15)	Mer ridée	0 mm/1h	7 km/h raf.20.9	30%	431	-2.5 °C	1018.7hPa ↗
12h	12.8 °C (10.5 → 12.8)	Mer belle	0 mm/1h	18 km/h raf.38.2	36%	394	-1.9 °C	1019.2hPa ↗
11h	10.4 °C (8.3 → 10.4)	Mer belle	0 mm/1h	22 km/h raf.33.1	39%	311	-3 °C	1019.1hPa ↗
10h	8.3 °C (6.9 → 8.3)	Mer belle	0 mm/1h	25 km/h raf.36.7	45%	4.6 192	-3 °C	1018.5hPa ↗
09h	6.9 °C (6.2 → 6.9)	Mer belle	0 mm/1h	25 km/h raf.36.4	48%	2.9 47	-3.4 °C	1017.8hPa ↗
08h	6.2 °C (6.2 → 6.7)	Mer belle	0 mm/1h	25 km/h raf.35.6	50%	2	-3.5 °C	1016.7hPa ↗
07h	6.6 °C (6.5 → 7)	○	0 mm/1h	25 km/h raf.36.4	49%	2.5	-3.4 °C	1016.2hPa ↗
06h	7.0 °C (7 → 7.5)	○	0 mm/1h	25 km/h raf.33.5	49%	3	-3 °C	1015.6hPa ↗
05h	7.4 °C (7.4 → 7.9)	○	0 mm/1h	25 km/h raf.32.8	48%	3.5	-2.9 °C	1014.9hPa ↗
04h	7.8 °C (7.6 → 8.2)	○	0 mm/1h	14 km/h raf.25.2	49%	5.2	-2.3 °C	1014.9hPa ↗

Figure 16 Dawn temperatures at the Nice sensor

translation in progress

Heure locale	Température	Pluie	Vent	Humidité	Bio-météo	Pt. de rosée
13h00	12.0 °C	0 mm/1h	3 km/h	49%		1.6 °C
12h30	11.7 °C		2 km/h	51%		1.9 °C
12h00	11.4 °C	0 mm/1h	3 km/h	52%		1.9 °C
11h30	10.7 °C		0 km/h	50%		0.7 °C
11h00	9.3 °C	0 mm/1h	0 km/h	53%	9.3	0.2 °C
10h30	6.3 °C		0 km/h	55%	6.3	-2.1 °C
10h00	2.9 °C	0 mm/1h	0 km/h	73%	2.9	-1.4 °C
09h30	0.3 °C		0 km/h	73%	0.3	-3.9 °C
09h00	-1.3 °C	0 mm/1h	0 km/h	75%	-1.3	-5.2 °C
08h30	-1.8 °C		0 km/h	74%	-1.8	-5.9 °C
08h00	-1.7 °C	0 mm/1h	0 km/h	72%	-1.7	-6.1 °C
07h30	-1.6 °C		0 km/h	71%	-1.6	-6.1 °C
07h00	-1.3 °C	0 mm/1h	0 km/h	74%	-1.3	-5.3 °C
06h30	-0.4 °C		0 km/h	72%	-0.4	-4.8 °C
06h00	-0.8 °C	0 mm/1h	0 km/h	73%	-0.8	-5 °C

Figure 17 Dawn temperatures at the Corte sensor

Hence at 9:00 a.m., a temperature gradient per meter of:

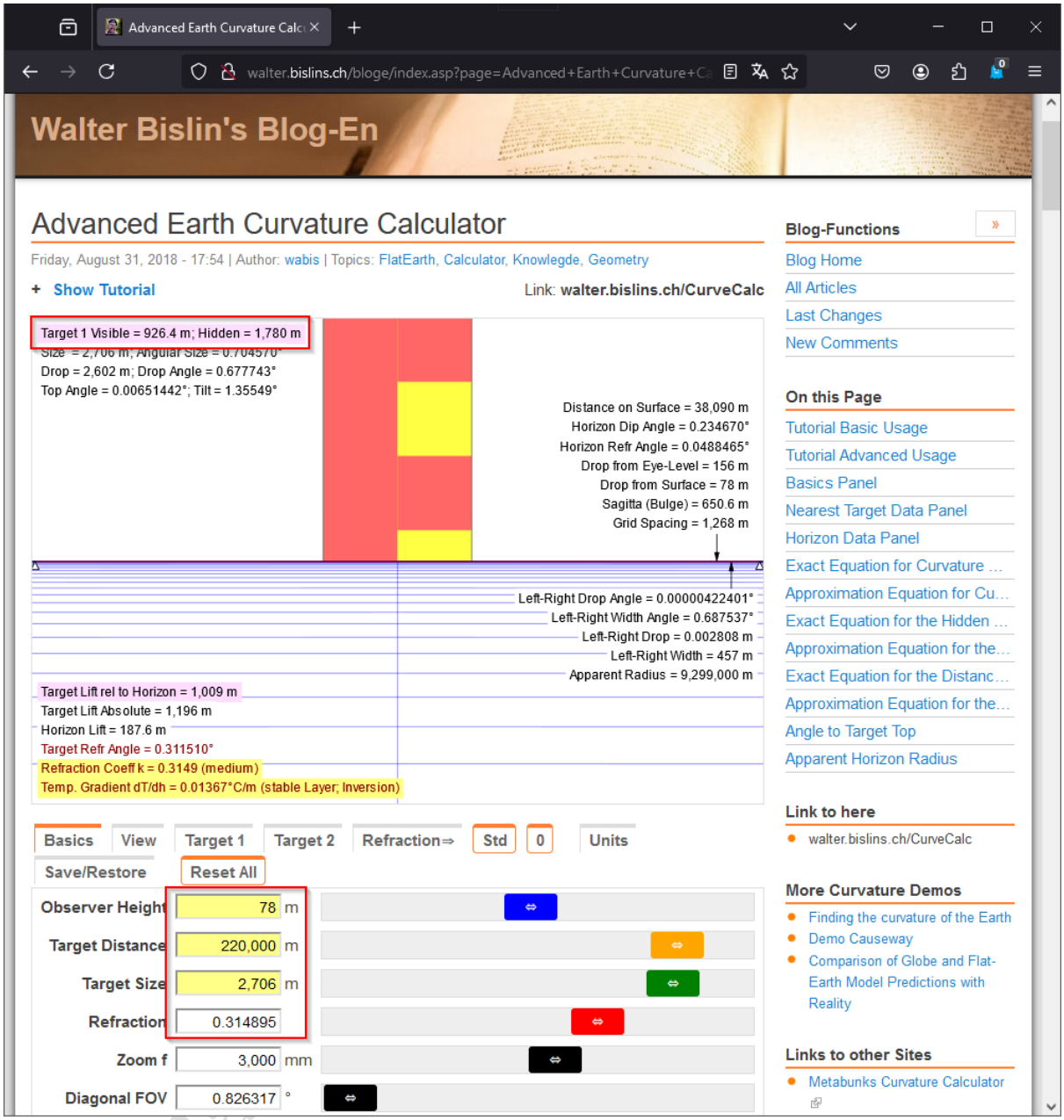
$$\frac{6.9° + 1.3°}{470 - 4} = \frac{8.2°}{466} \cong 0.017$$

With these informations and using:

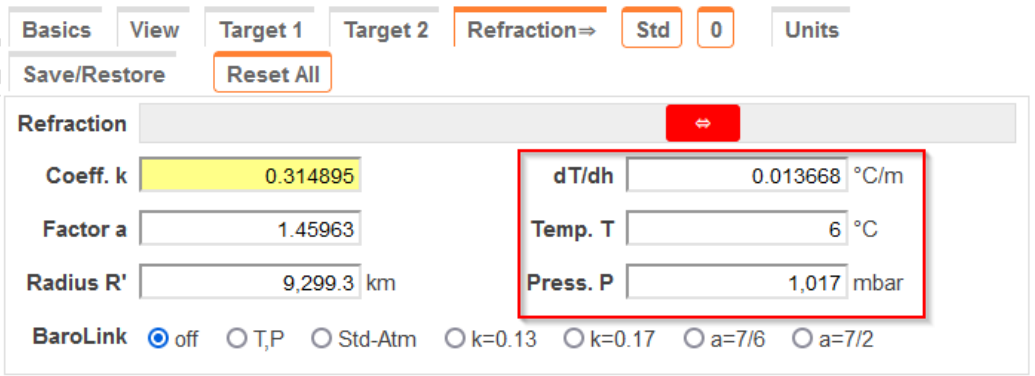
http://walter.bislins.ch/bloge/index.asp?page=Advanced+Earth+Curvature+Calculator

We then have with all this data:

translation in progress


Advanced Earth Curvature Calc
walter.bislins.ch/bloge/index.asp?page=Advanced+Earth+Curvature+Ca
Walter Bislin's Blog-En
Advanced Earth Curvature Calculator
Friday, August 31, 2018 - 17:54 | Author: wabis | Topics: FlatEarth, Calculator, Knowlegde, Geometry
+ Show Tutorial
Link: walter.bislins.ch/CurveCalc
Target 1 Visible = 926.4 m; Hidden = 1,780 m
Drop = 2,602 m; Drop Angle = 0.677743°
Top Angle = 0.00651442°; Tilt = 1.35549°
Distance on Surface = 38,090 m
Horizon Dip Angle = 0.234670°
Horizon Refr Angle = 0.0488465°
Drop from Eye-Level = 156 m
Drop from Surface = 78 m
Sagitta (Bulge) = 650.6 m
Grid Spacing = 1,268 m
Left-Right Drop Angle = 0.00000422401°
Left-Right Width Angle = 0.687537°
Left-Right Drop = 0.002808 m
Left-Right Width = 457 m
Apparent Radius = 9,299,000 m
Target Lift rel to Horizon = 1,009 m
Target Lift Absolute = 1,196 m
Horizon Lift = 187.6 m
Target Refr Angle = 0.311510°
Refraction Coeff k = 0.3149 (medium)
Temp. Gradient dT/dh = 0.01367°C/m (stable Layer; Inversion)
Basics
View
Target 1
Target 2
Refraction⇒
Std
0
Units
Save/Restore
Reset All
Observer Height 78 m
Target Distance 220,000 m
Target Size 2,706 m
Refraction 0.314895
Zoom f 3,000 mm
Diagonal FOV 0.826317 °
Blog-Functions
Blog Home
All Articles
Last Changes
New Comments
On this Page
Tutorial Basic Usage
Tutorial Advanced Usage
Basics Panel
Nearest Target Data Panel
Horizon Data Panel
Exact Equation for Curvature ...
Approximation Equation for Cu...
Exact Equation for the Hidden ...
Approximation Equation for the...
Exact Equation for the Distanc...
Approximation Equation for the...
Angle to Target Top
Apparent Horizon Radius
Link to here
walter.bislins.ch/CurveCalc
More Curvature Demos
Finding the curvature of the Earth
Demo Causeway
Comparison of Globe and Flat-Earth Model Predictions with Reality
Links to other Sites
Metabunks Curvature Calculator

And where we put according to the data from the weather stations:



So the calculated result is in excellent conformity with empirical observation and therefore contradicts the arguments of the flat-earthers.

So not only do we prove that the oblate Earth model explains the phenomenon, but the fact that Corsica is not visible during excellent visibility conditions but with a low temperature gradient also proves that the Earth is not flat. Not to mention the fact that when Corsica is visible it is only partially so!

translation into english ongoing

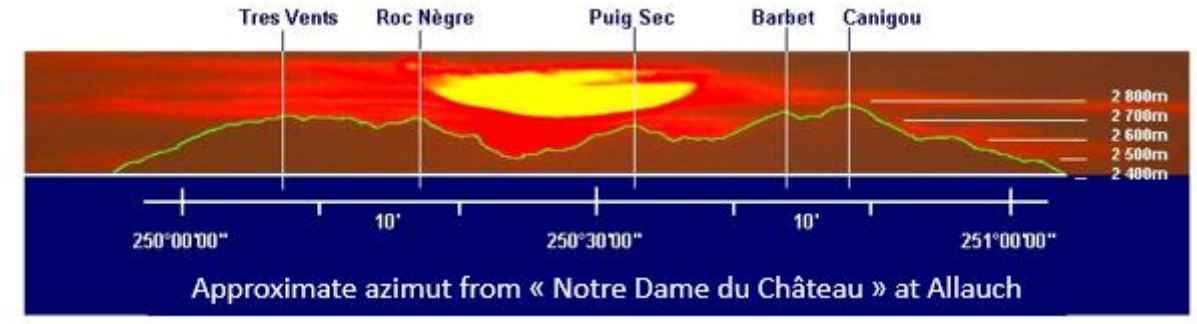
(#021) Mont Canigou from Cagnes-Sur-Mer/Nice (France)

The relationship given above also perfectly explains why in some rare atmospheric conditions and for a particular position of the Sun it is possible a few times a year (unlike a flat Earth where it should be possible every day!) to see the heights of Mount Canigou (mountain peaks of the eastern Pyrenees) from the heights of Marseille:

Figure 18 Mount Canigou from Marseille late afternoon on Friday October 11 (photo : Laurent Ferrero, source : http://splendeursducielprofond.eklablog.fr)

Dark peaks (only the peaks, obviously...) are visible above the Mediterranean Sea, they are visible around the wind turbines located off the coast of the Camargue. Here are the two peaks of Canigou (2785 m) and Barbet (2745 m) which resemble two overlapping pyramids. To its left, the small peak of Puig Sec (2665 m) is also visible, although discreet because it is lower. And completely to the left, the dark bar of Tres Vents and the summit of Roc Nègre (2714 m) draw a perfectly recognizable silhouette, although it lacks contrast.

translation



The observation of the photo is reproducible by computer:

https://www.peakfinder.com/fr/?lat=43.35832&lng=5.41211&azi=250&alt=1.2&fov=11.02&date=2024-11-03T16:28:30Z&cfg=smr&name=

The phenomenon can be explained by the following simple diagram:

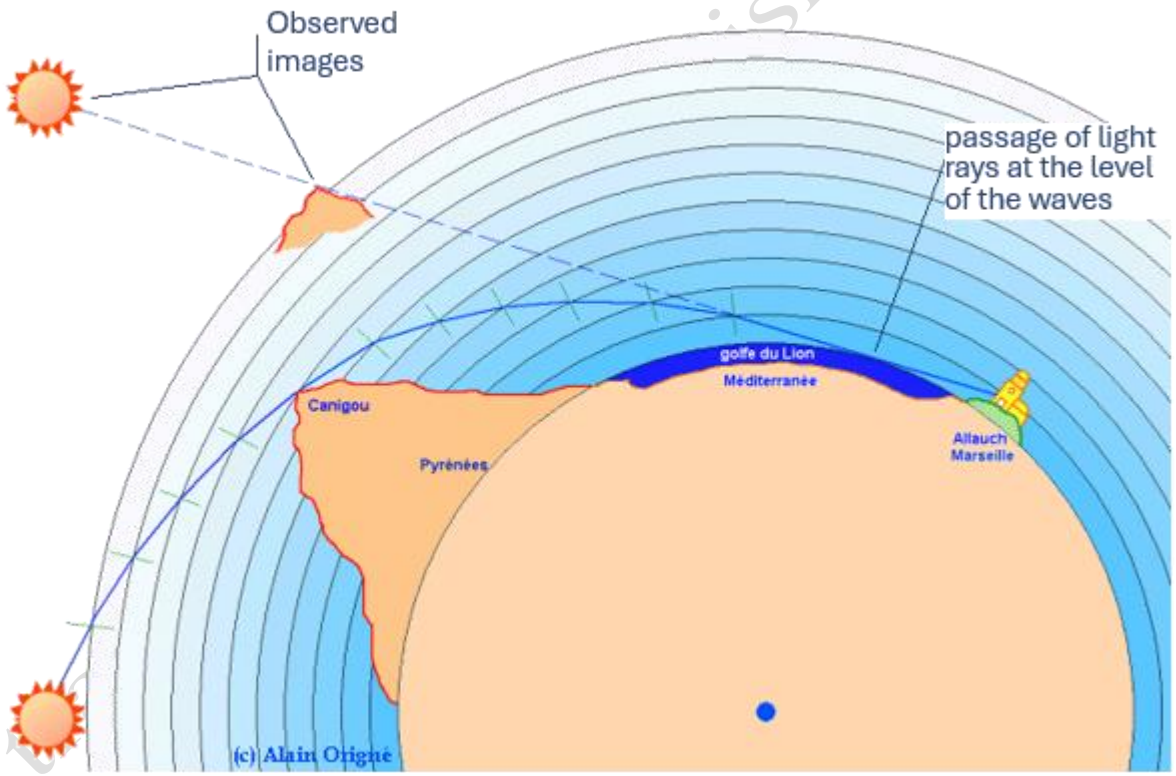


Figure Illustration of the refraction of Mount Canigou (source : http://canigou.allauch.free.fr/Explications.htm)

The configuration is as follows:

Figure 19 Geographic location/distance Mont Canigou to Allauch (source : http://canigou.allauch.free.fr)

With obviously:

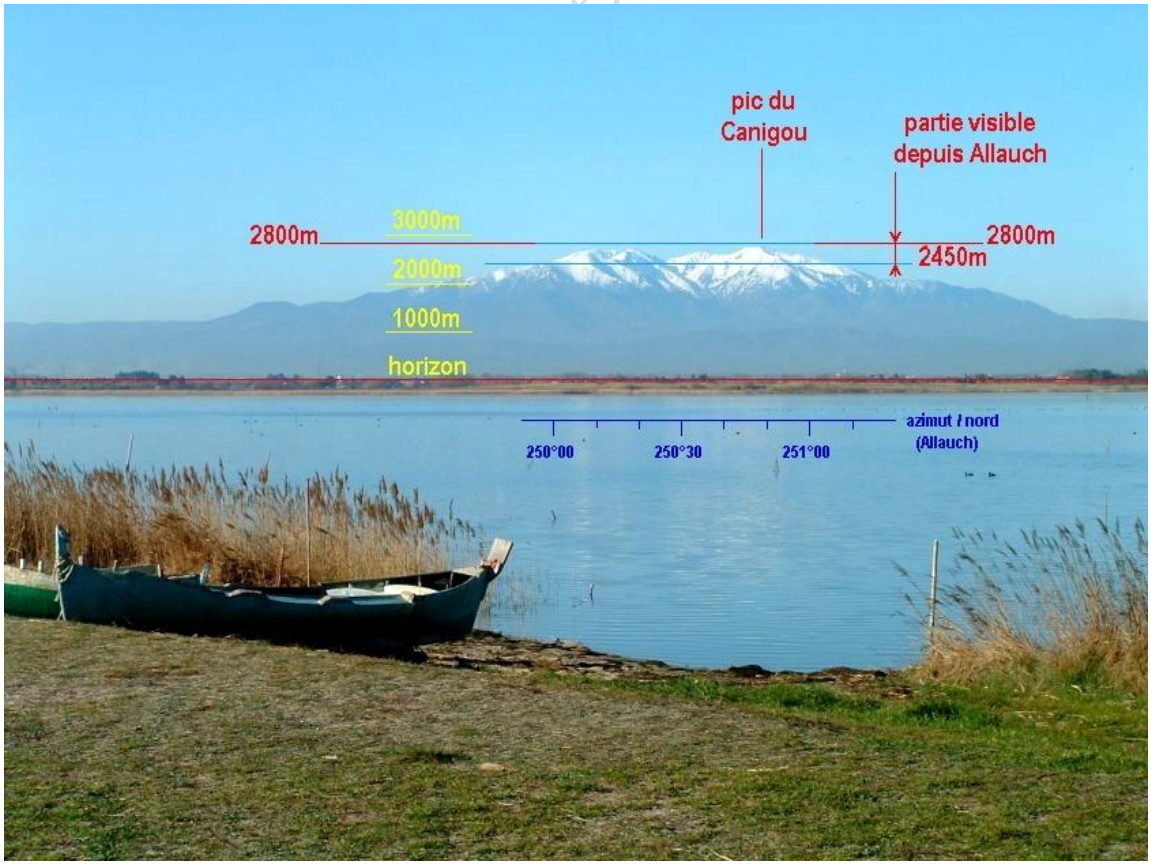


Figure 20 Comparison of totality vs hidden height from Allauch (source : http://canigou.allauch.free.fr)

Or also (the image on the left is taken from https://www.youtube.com/watch?v=CIIDhOb8MZ0 where the photo is taken at an altitude of 106 meters from the chapel of Notre Dame des Marins in Martigues):

On that day, October 11, 2024, here is what the archives of the closest weather stations we found give in terms of proximity to points of interest:

https://www.infoclimat.fr/observations-meteo/archives/

Font-Romeu-Odeillo-Via capteur Réseau StatIC	1788 meters 42,52°N | 2,06°E	Time ? Minimum Temp.	11 october 2024	4.1 degress Celsius
Marseille	192 meters 43,31°N | 5,48°E	Time ? Minimum Temp.	11 october 2024	11 degrees Celsius

So at this unknown time we have a temperature gradient per meter of:

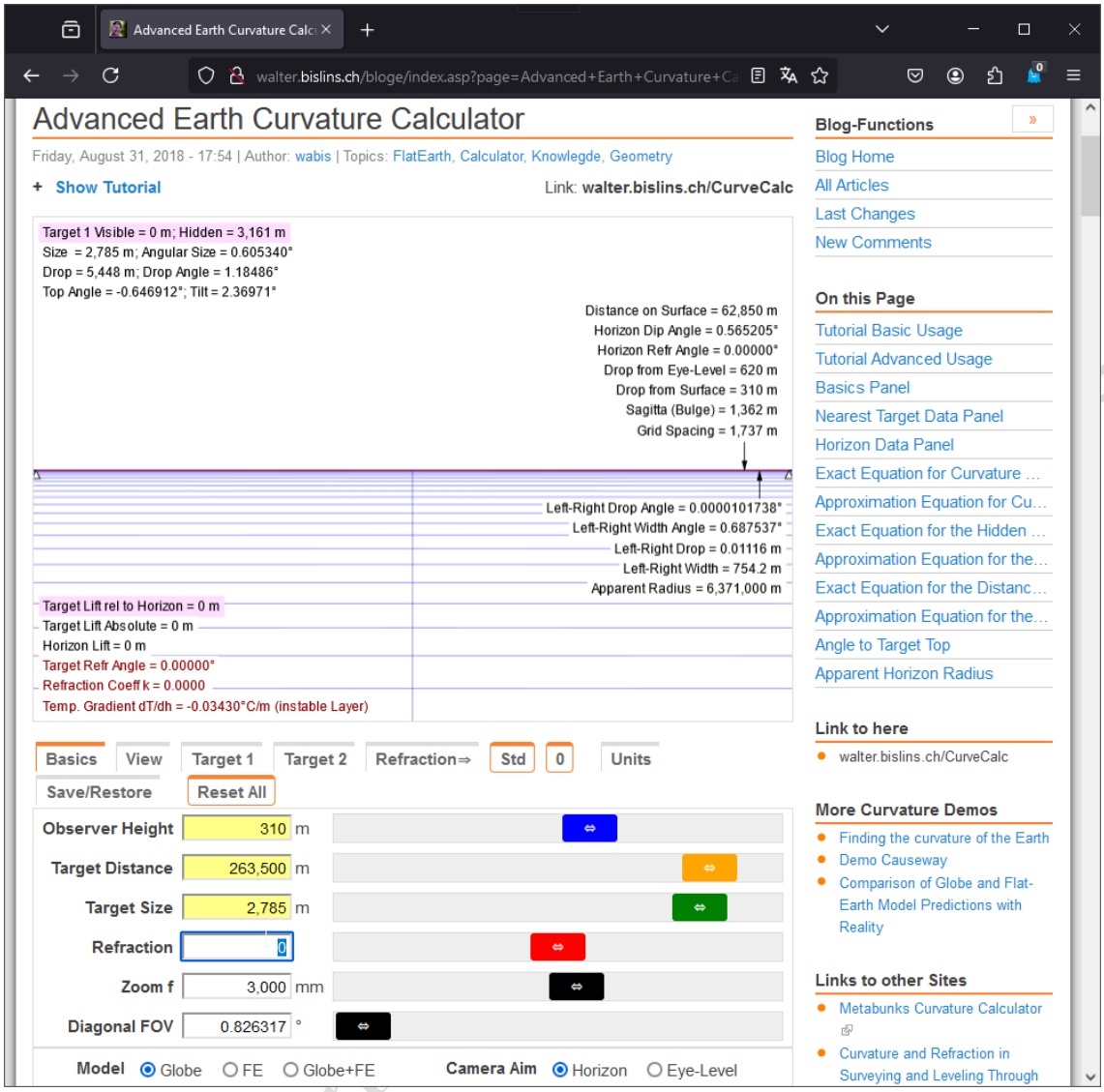
$$\frac{11^\circ - 4.1^\circ}{1788 - 192} = \frac{6.9^\circ}{1596} \cong 0.0043$$

With these informations and using:

http://walter.bislins.ch/bloge/index.asp?page=Advanced+Earth+Curvature+Calculator

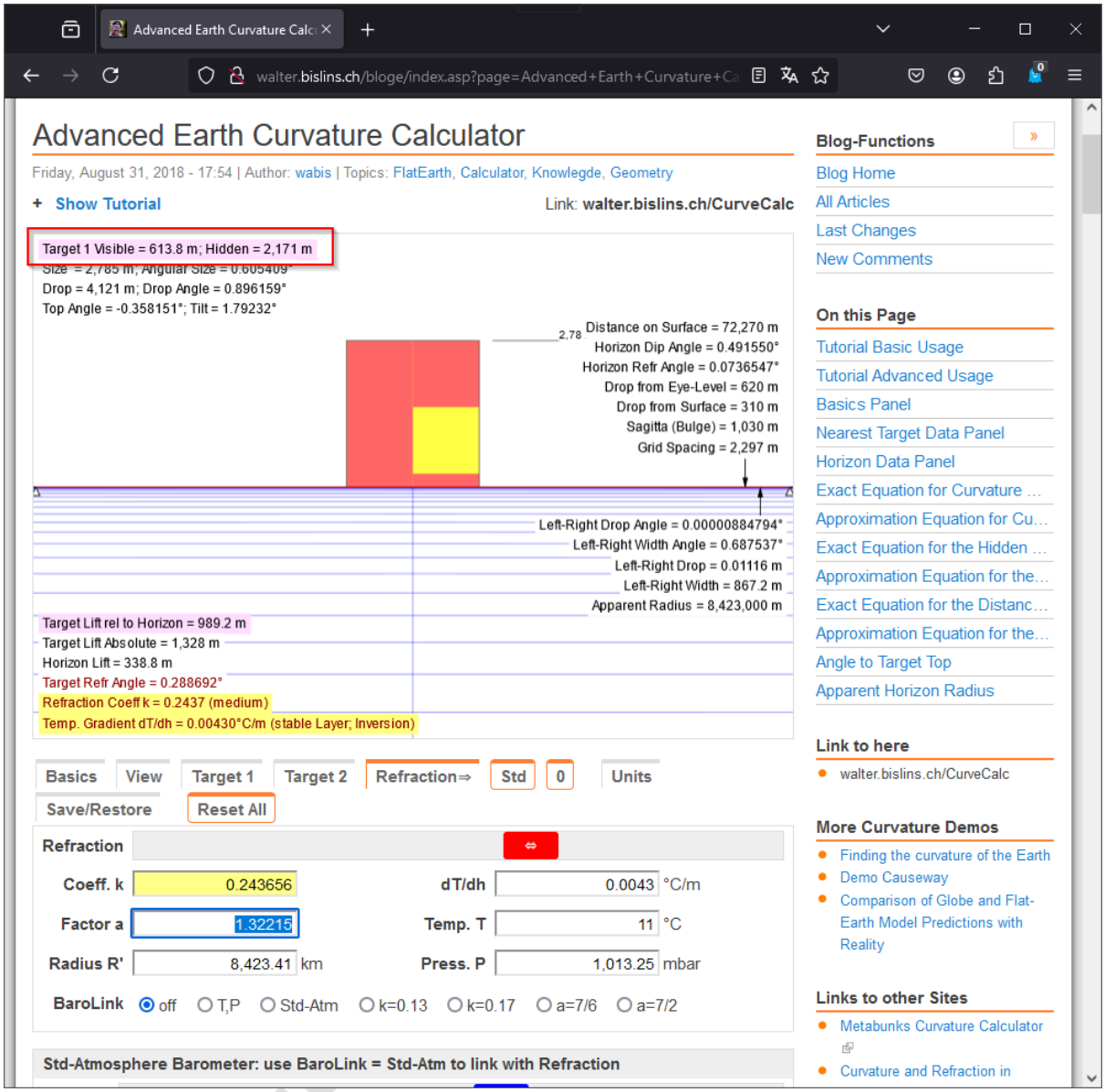
We then have with all this data first without refraction (and without surprises!):

translation into engl


Advanced Earth Curvature Calc
walter.bislins.ch/bloge/index.asp?page=Advanced+Earth+Curvature+Ca
Advanced Earth Curvature Calculator
Friday, August 31, 2018 - 17:54 | Author: wabis | Topics: FlatEarth, Calculator, Knowlegde, Geometry
+ Show Tutorial
Link: walter.bislins.ch/CurveCalc
Target 1 Visible = 0 m; Hidden = 3,161 m
Size = 2,785 m; Angular Size = 0.605340°
Drop = 5,448 m; Drop Angle = 1.18486°
Top Angle = -0.646912°; Tilt = 2.36971°
Distance on Surface = 62,850 m
Horizon Dip Angle = 0.565205°
Horizon Refr Angle = 0.00000°
Drop from Eye-Level = 620 m
Drop from Surface = 310 m
Sagitta (Bulge) = 1,362 m
Grid Spacing = 1,737 m
Left-Right Drop Angle = 0.0000101738°
Left-Right Width Angle = 0.687537°
Left-Right Drop = 0.01116 m
Left-Right Width = 754.2 m
Apparent Radius = 6,371,000 m
Target Lift rel to Horizon = 0 m
Target Lift Absolute = 0 m
Horizon Lift = 0 m
Target Refr Angle = 0.00000°
Refraction Coeff k = 0.0000
Temp. Gradient dT/dh = -0.03430°C/m (instable Layer)
Basics
View
Target 1
Target 2
Refraction⇒
Std
0
Units
Save/Restore
Reset All
Observer Height 310 m
Target Distance 263,500 m
Target Size 2,785 m
Refraction 0
Zoom f 3,000 mm
Diagonal FOV 0.826317 °
Model Globe FE Globe+FE
Camera Aim Horizon Eye-Level
Blog-Functions
Blog Home
All Articles
Last Changes
New Comments
On this Page
Tutorial Basic Usage
Tutorial Advanced Usage
Basics Panel
Nearest Target Data Panel
Horizon Data Panel
Exact Equation for Curvature ...
Approximation Equation for Cu...
Exact Equation for the Hidden ...
Approximation Equation for the...
Exact Equation for the Distanc...
Approximation Equation for the...
Angle to Target Top
Apparent Horizon Radius
Link to here
walter.bislins.ch/CurveCalc
More Curvature Demos
Finding the curvature of the Earth
Demo Causeway
Comparison of Globe and Flat-Earth Model Predictions with Reality
Links to other Sites
Metabunks Curvature Calculator
Curvature and Refraction in Surveying and Leveling Through

And with refraction by putting the temperature gradient calculated above:

translation



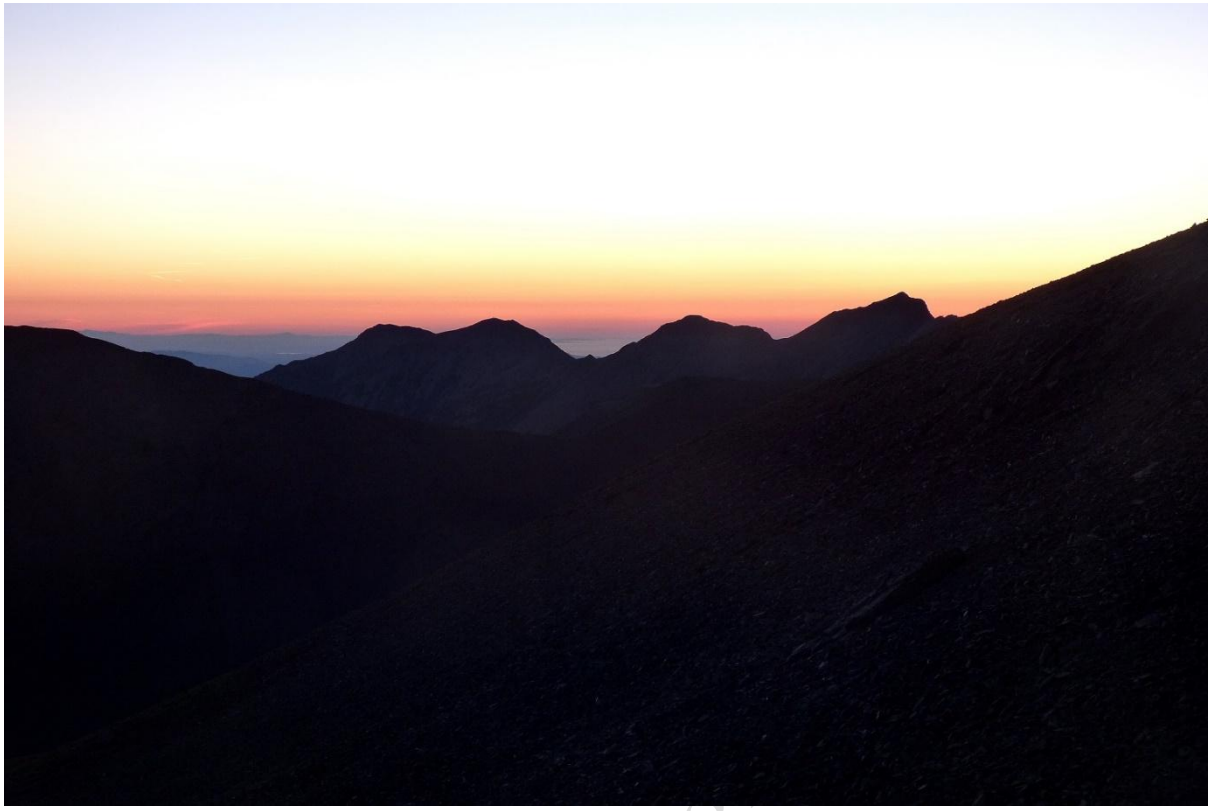
Which is again in excellent conformity with what is observed! Once again a point for the oblate Earth and the flat Earth is put in the ring ropes...

translation

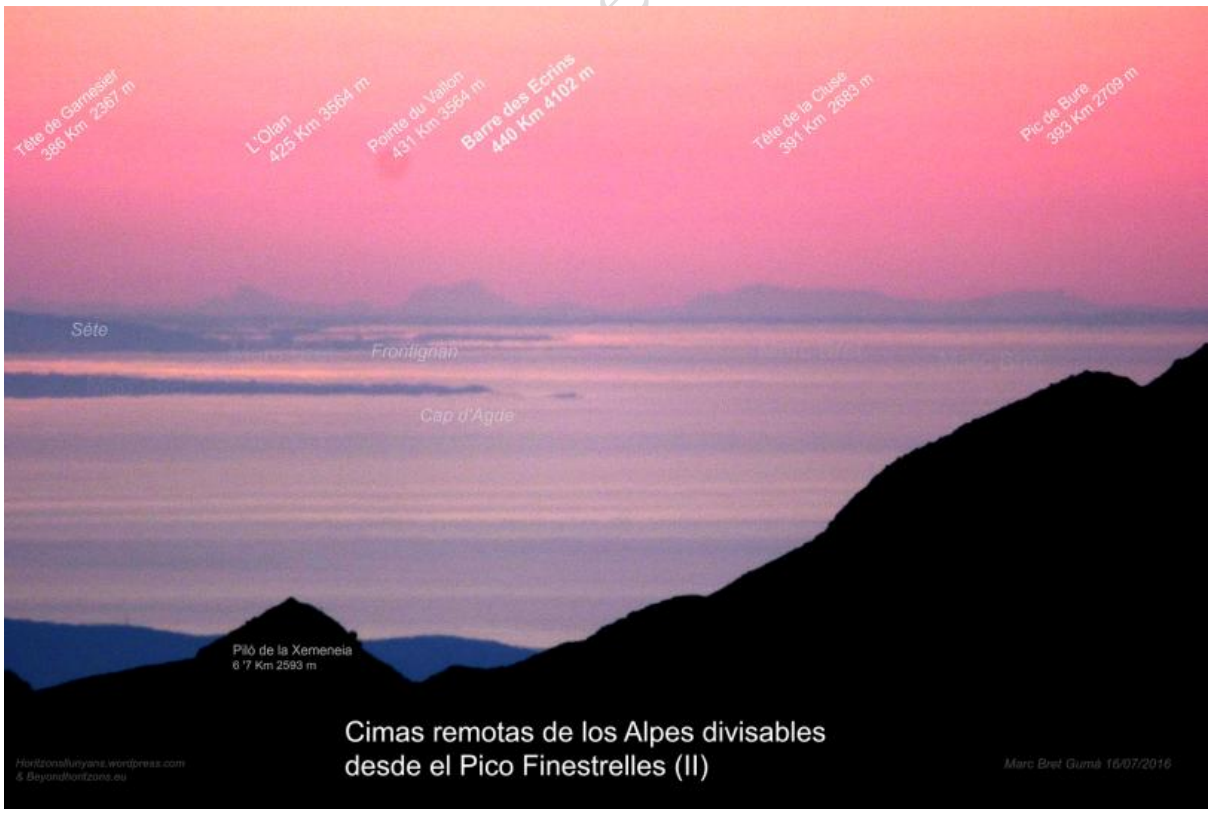
(#022) Alpes from the Pyrénées

At the day we write these lines, this is the world record for distance photography by photographer Mark Bret (July 16, 2016). The Barre des Écrins (4102 meters), in the Alps, from a summit in the Pyrenees, the Pic de Finestrelles, at an altitude of 2826 meters, a distance of 433 km (Panasonic Lumix FZ72 @ ISO100 – 1/250, Integrated Zoom @ 1200 mm (equiv.) – f./2.8):

The photo visible above is a crop of the following wide-angle photo:

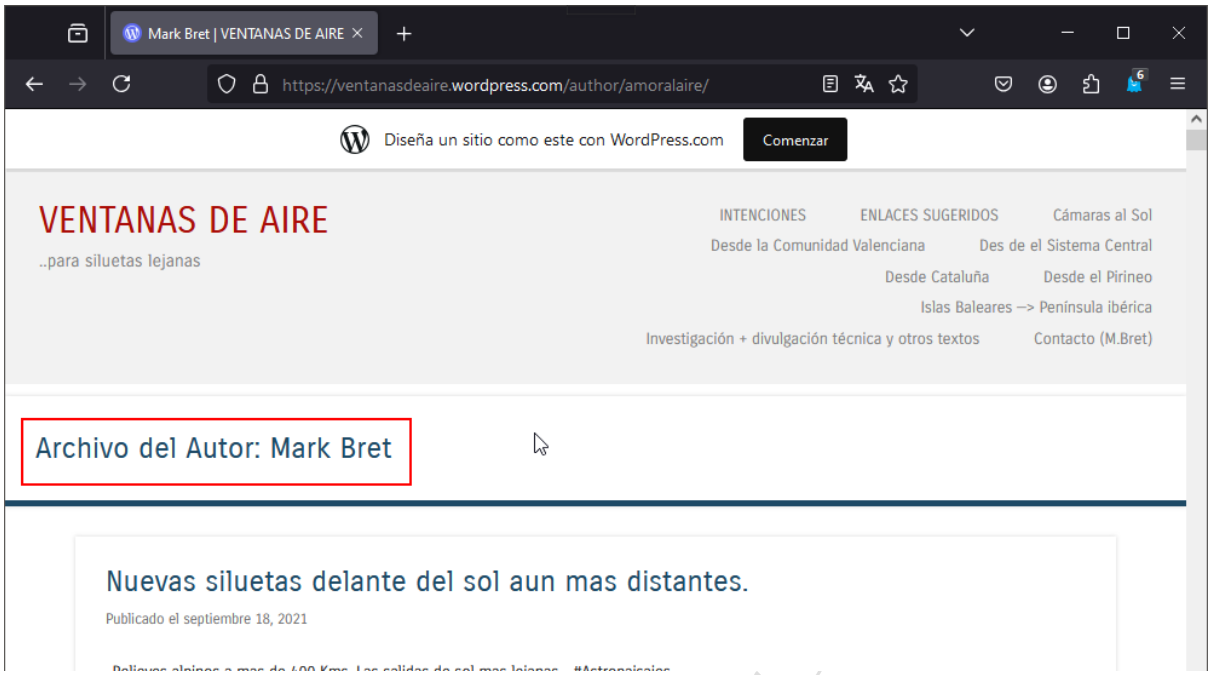


With the captions:

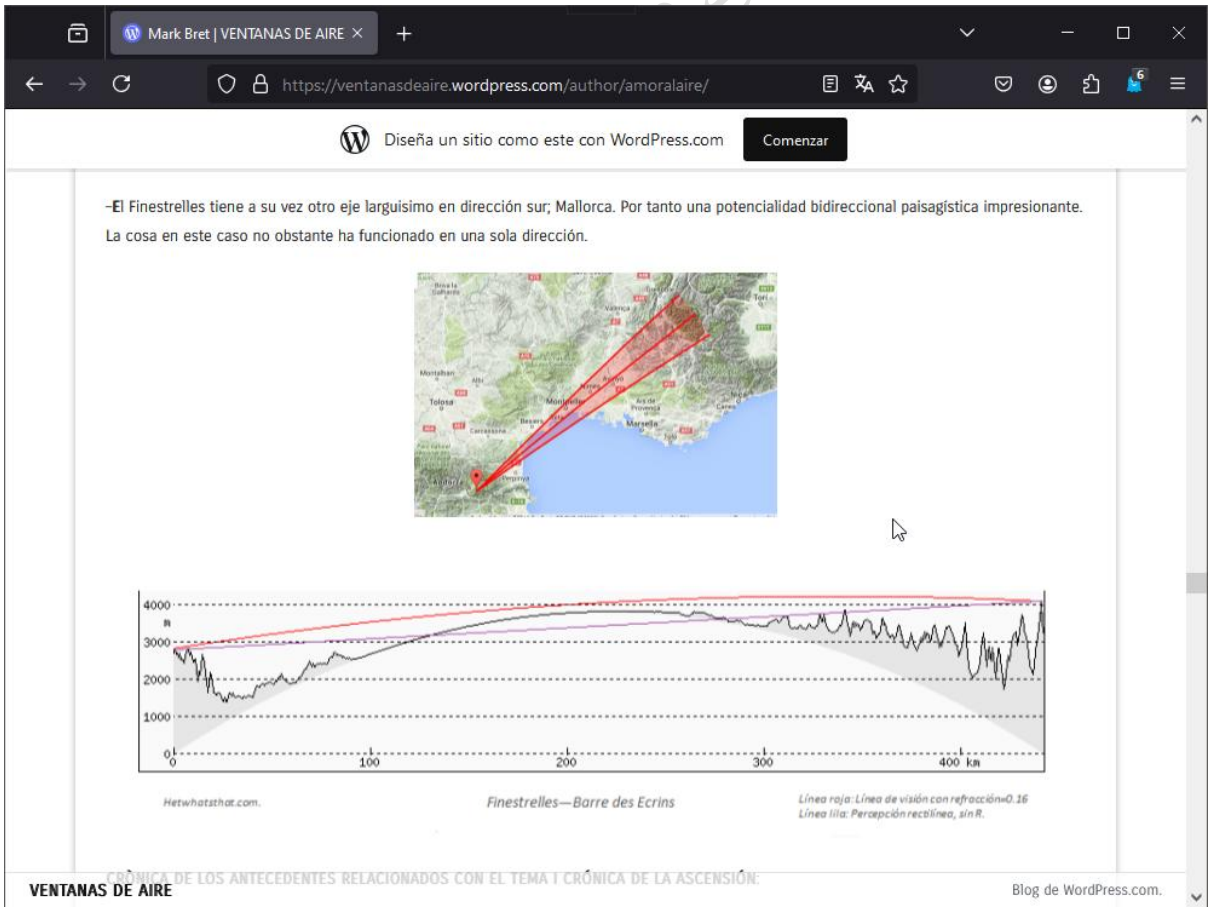


As Mark Bret says on his own blog:

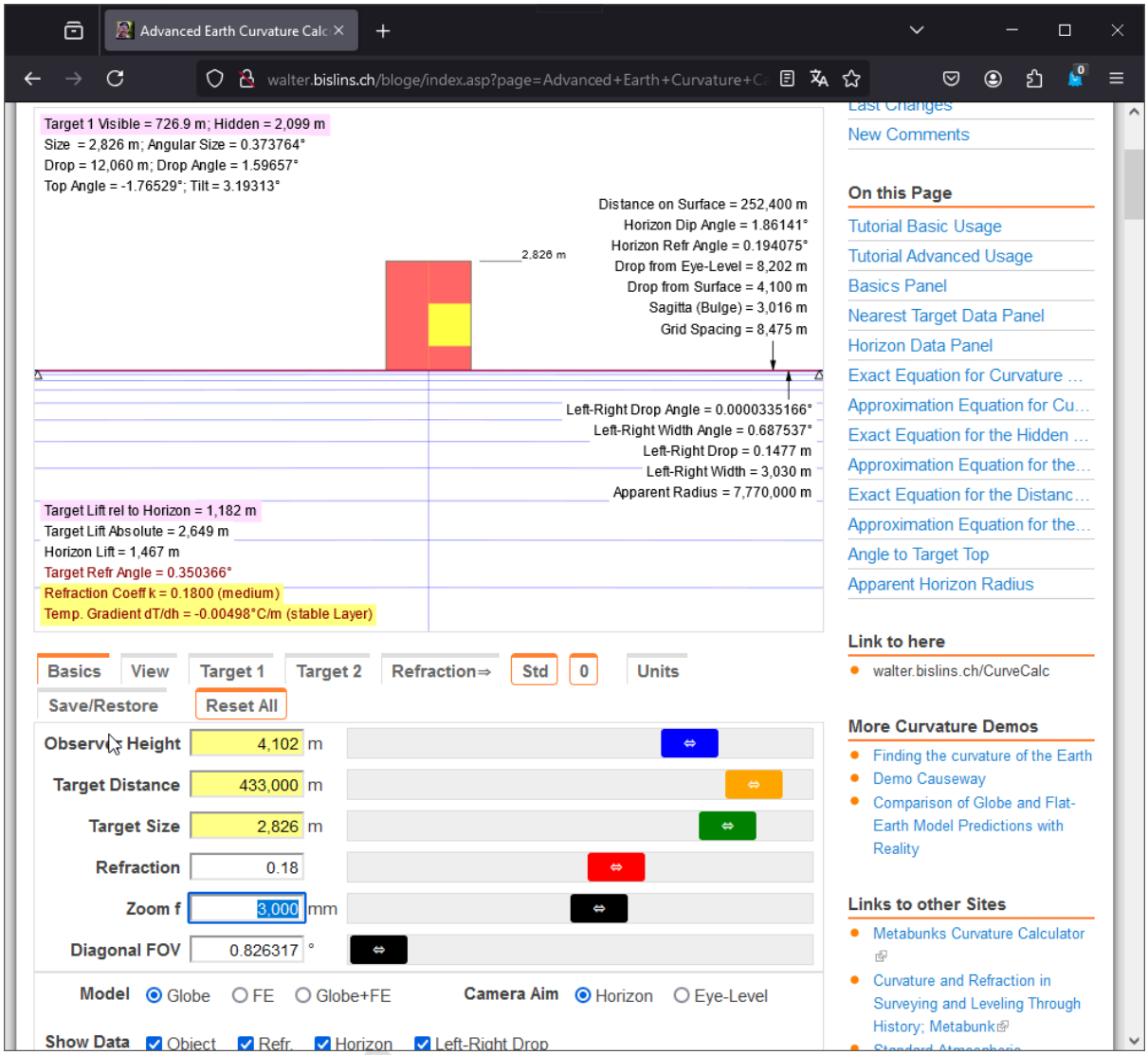
https://ventanasdeaire.wordpress.com/author/amoralaire



he therefore specifies himself and illustrates that this is indeed due to atmospheric refraction:



We can check this with the reference online calculator:

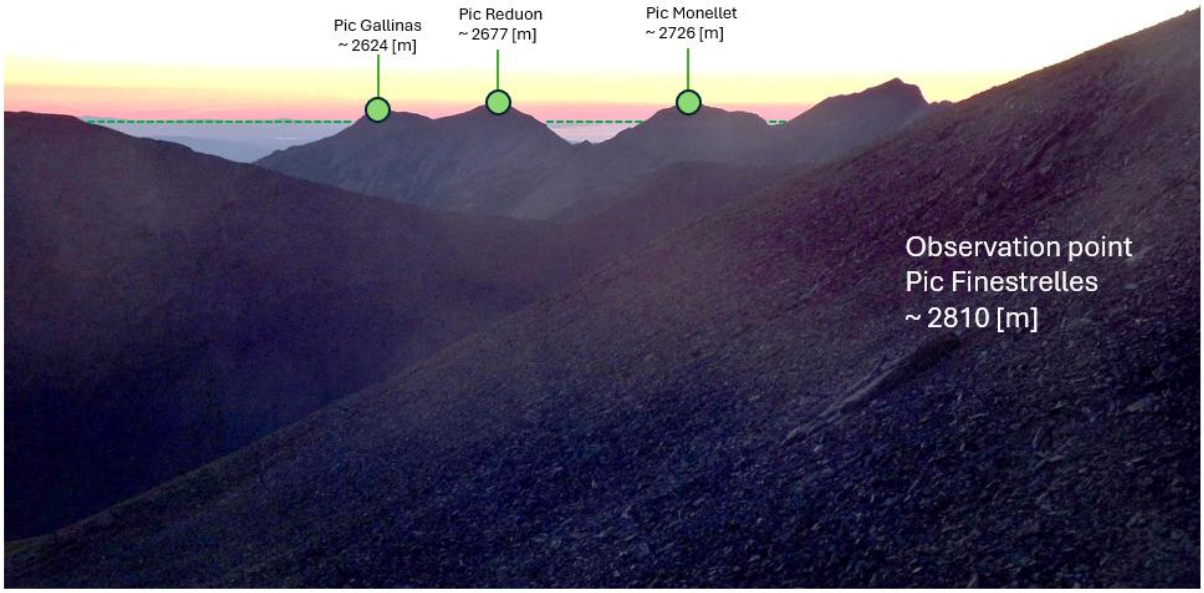

Advanced Earth Curvature Calc
walter.bislins.ch/bloge/index.asp?page=Advanced+Earth+Curvature+C
Target 1 Visible = 726.9 m; Hidden = 2,099 m
Size = 2,826 m; Angular Size = 0.373764°
Drop = 12,060 m; Drop Angle = 1.59657°
Top Angle = -1.76529°; Tilt = 3.19313°
Distance on Surface = 252,400 m
Horizon Dip Angle = 1.86141°
Horizon Refr Angle = 0.194075°
Drop from Eye-Level = 8,202 m
Drop from Surface = 4,100 m
Sagitta (Bulge) = 3,016 m
Grid Spacing = 8,475 m
2,826 m
Left-Right Drop Angle = 0.0000335166°
Left-Right Width Angle = 0.687537°
Left-Right Drop = 0.1477 m
Left-Right Width = 3,030 m
Apparent Radius = 7,770,000 m
Target Lift rel to Horizon = 1,182 m
Target Lift Absolute = 2,649 m
Horizon Lift = 1,467 m
Target Refr Angle = 0.350366°
Refraction Coeff k = 0.1800 (medium)
Temp. Gradient dT/dh = -0.00498°C/m (stable Layer)
Basics
View
Target 1
Target 2
Refraction⇒
Std
0
Units
Save/Restore
Reset All
Observ Height 4,102 m
Target Distance 433,000 m
Target Size 2,826 m
Refraction 0.18
Zoom f 3,000 mm
Diagonal FOV 0.826317 °
Model Globe FE Globe+FE
Camera Aim Horizon Eye-Level
Show Data Object Refr. Horizon Left-Right Drop
New Comments
On this Page
Tutorial Basic Usage
Tutorial Advanced Usage
Basics Panel
Nearest Target Data Panel
Horizon Data Panel
Exact Equation for Curvature ...
Approximation Equation for Cu...
Exact Equation for the Hidden ...
Approximation Equation for the...
Exact Equation for the Distanc...
Approximation Equation for the...
Angle to Target Top
Apparent Horizon Radius
Link to here
walter.bislins.ch/CurveCalc
More Curvature Demos
Finding the curvature of the Earth
Demo Causeway
Comparison of Globe and Flat-Earth Model Predictions with Reality
Links to other Sites
Metabunks Curvature Calculator
Curvature and Refraction in Surveying and Leveling Through History; Metabunk

Hence a gradient of only 0.00498 degrees Celsius per meter is enough for the observation to be a fact on the globe.

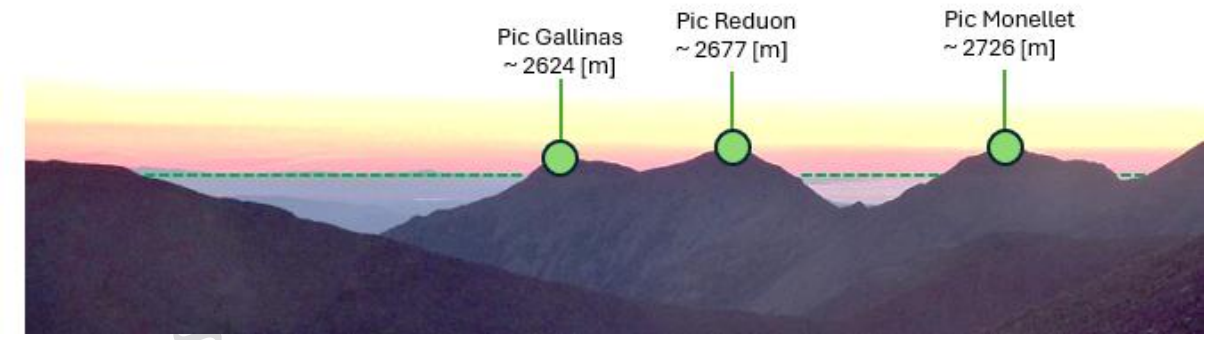
Whereas if the Earth was flat, this photo should be possible every (sunny and clear) day and not just on certain days of the year and flat Earth supporters cannot explain this!

There is also another very simple way to prove that the Earth is not flat with the original photo to which we have increased the brightness and added captions:

translation



The observation point is at least 70 m higher than the peaks highlighted above. This means the eye level is higher than these three peaks. So since the horizon is always at eye level according to flat-earthers... then why is the horizon below the three peaks???

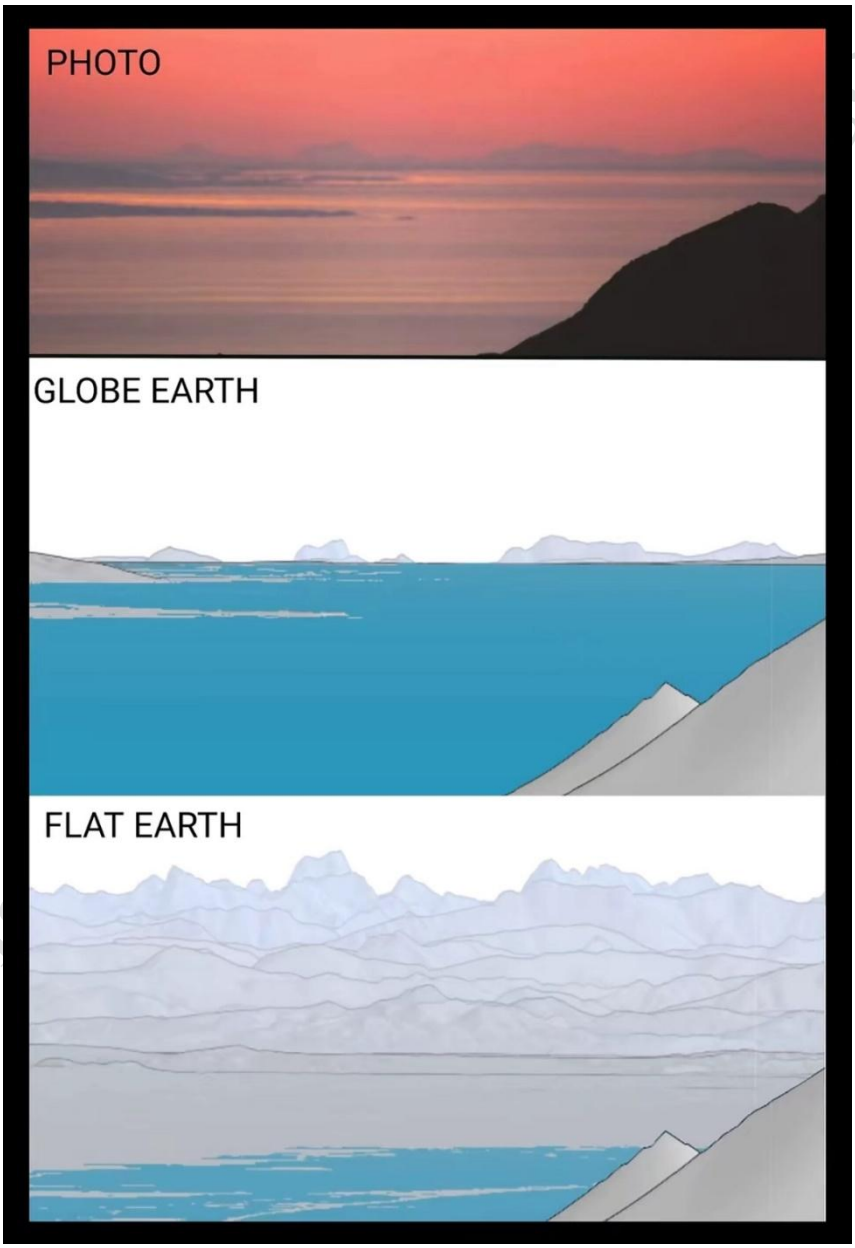


And we know that the horizontal line above is the horizon because the terrain is clearly visible as we saw above in the cropped photo!

If the Earth were flat... and the horizon always appeared at eye level... we would never have to look down to see the horizon... according to the axioms of the "flat-earther perspective."

In the flat-earther paradigm, this is what we would see if the Earth were flat as they describe it:

Or more explicitly, the image below is what we should see on a Flat Earth if we zoom on the background:



There is nothing more to say….

(#023-030) Civil constructions and leakage points

Here are seven vanishing points (Edmonton, Calgary, Alberta, Antwerp docks, Antwerp Kleidrecht lock, Washington D.C. ...) which prove that the Earth is not flat otherwise the vanishing point would not be above the Earth ground line:

We will later see another famous civil construction where the vanishing point is above the earth line (see page 82).

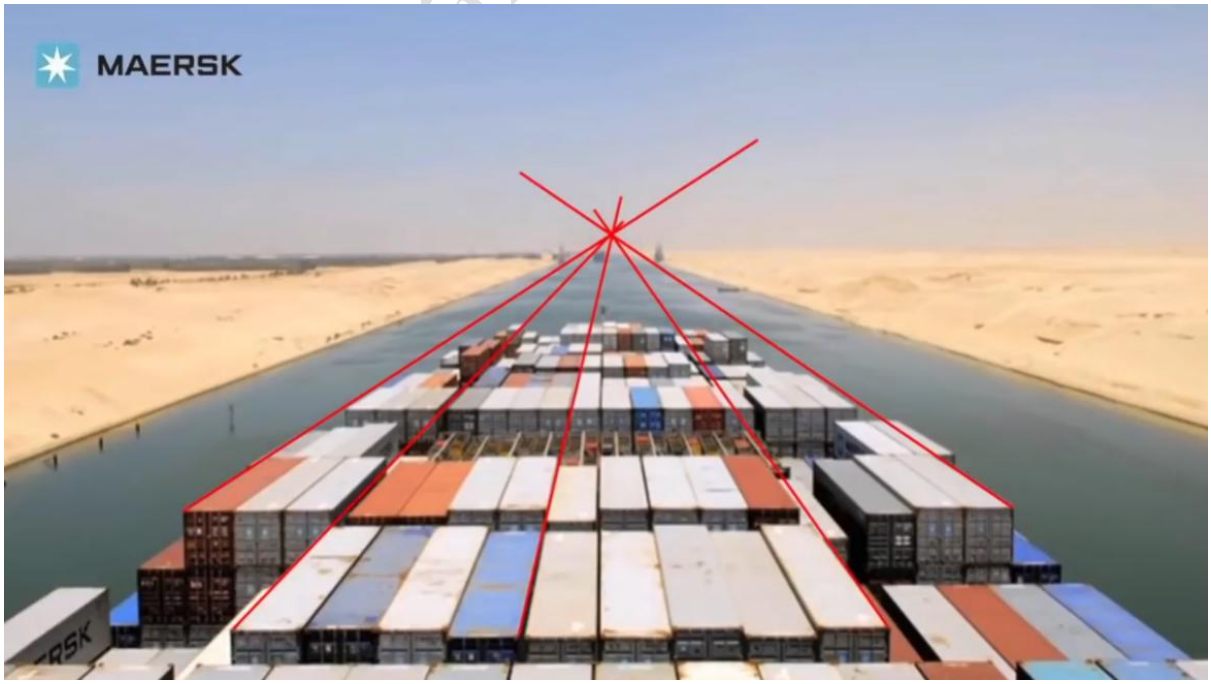
translation

(#031-034) Cargo ships on the Suez Canal and leak points Cargo ships on the Suez Canal and leak points

Observing vanishing points also proves the curvature of the Suez Canal. Below are four photos of the Suez Canal that prove the Earth is not flat because there is violation of the 3rd law of linear perspective.

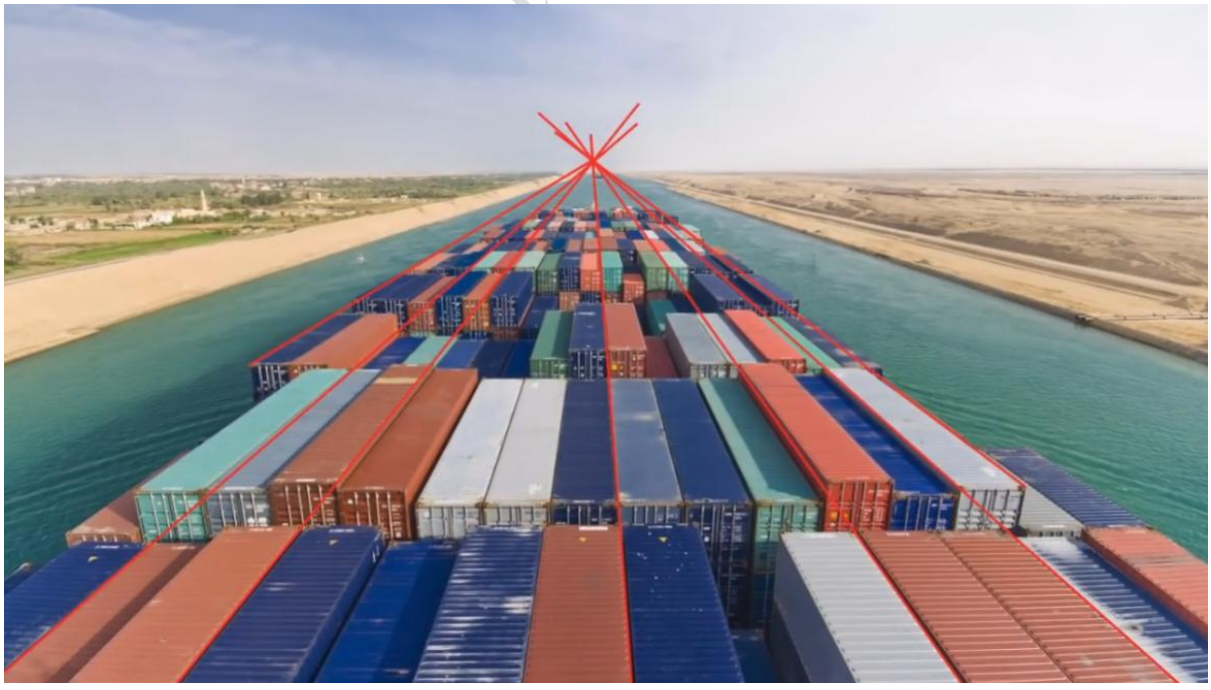
As below near Said Bridge:

And elsewhere on the canal:



Still at the Said Bridge:

Again elsewhere on the Suez Canal:



All this proves the curvature again...!

Civil constructions highlighting the curvature

There are hundreds of bridges, offshore platforms and wind farms around the world where the curvature of the Earth is obvious to those who can think.

There is a whole collection of boats and structures disappearing below the horizon available on the following TikTok account:

https://www.tiktok.com/@christian_avalos_antitp

(#035) Lake Pontchartrain Bridge (United States)

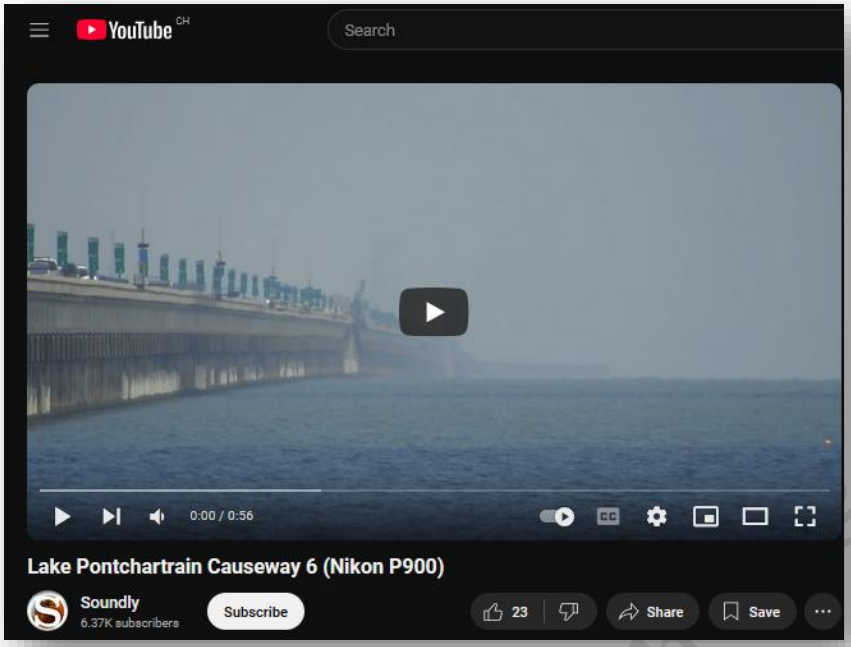
The Lake Pontchartrain Bridge in Louisiana, USA (30°21’34.20"N, 90°5’35.54"W) with a length of 38 kilometers is probably the most common case of obvious visibility of the curvature of the Earth with a bridge:

Figure 21 Lac Pontchartrain en Louisiane aux États-Unis avec Nikon P1000

The perspective in the photo above is compressed due to the high zoom, we see this in the ramps that appear exaggeratedly steep. So the actual curve is exaggerated, but there has to be a curve to begin with to have something to exaggerate!

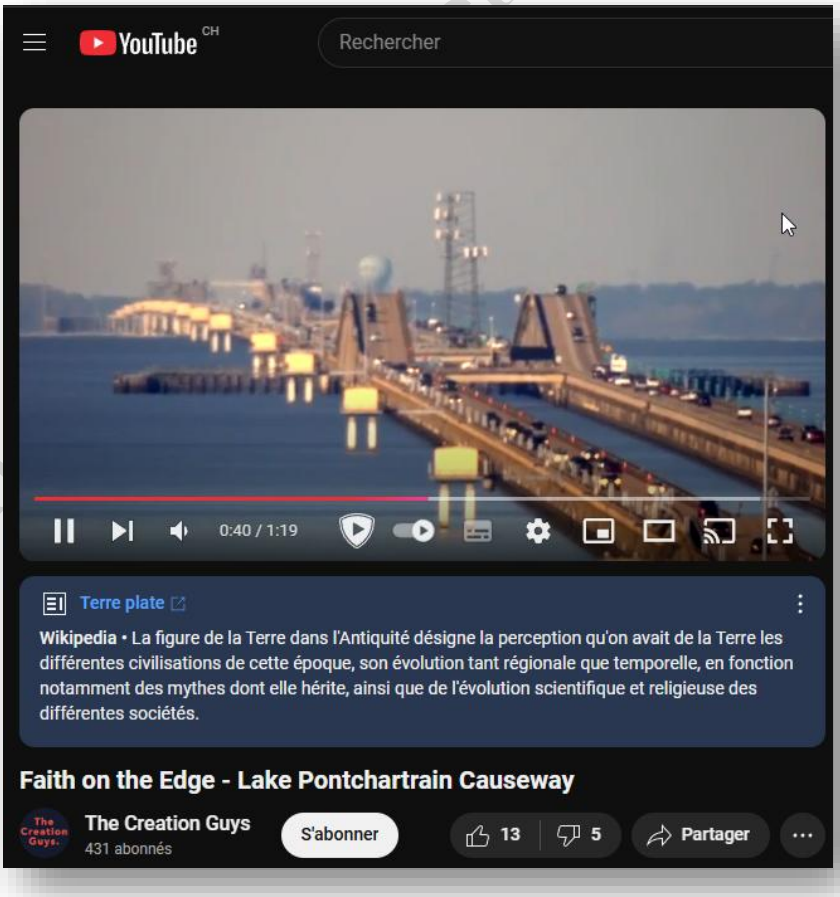
A video is also available on YouTube made with a Nikon P900:

https://www.youtube.com/watch?v=UHU9dj4zKLM

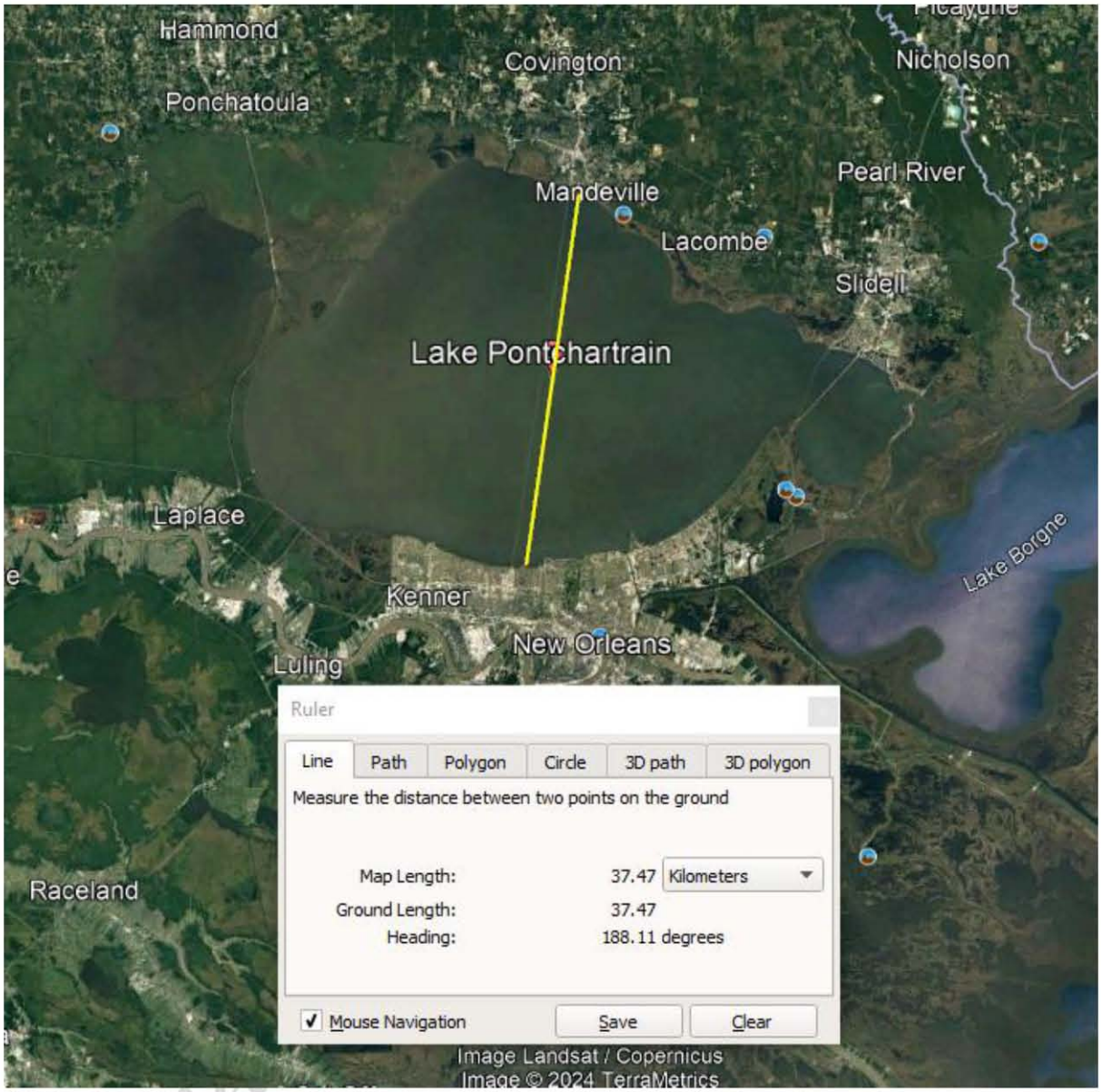


or another video here:

https://www.youtube.com/watch?v=AMlwBGC8Iug


YouTube CH
Rechercher
0:40 / 1:19
Terre plate
Wikipedia • La figure de la Terre dans l'Antiquité désigne la perception qu'on avait de la Terre les différentes civilisations de cette époque, son évolution tant régionale que temporelle, en fonction notamment des mythes dont elle hérite, ainsi que de l'évolution scientifique et religieuse des différentes sociétés.
Faith on the Edge - Lake Pontchartrain Causeway
The Creation Guys
431 abonnés
S'abonner
13
5
Partager

The situation of Lake Pontchartrain and its bridge is contextualized below:



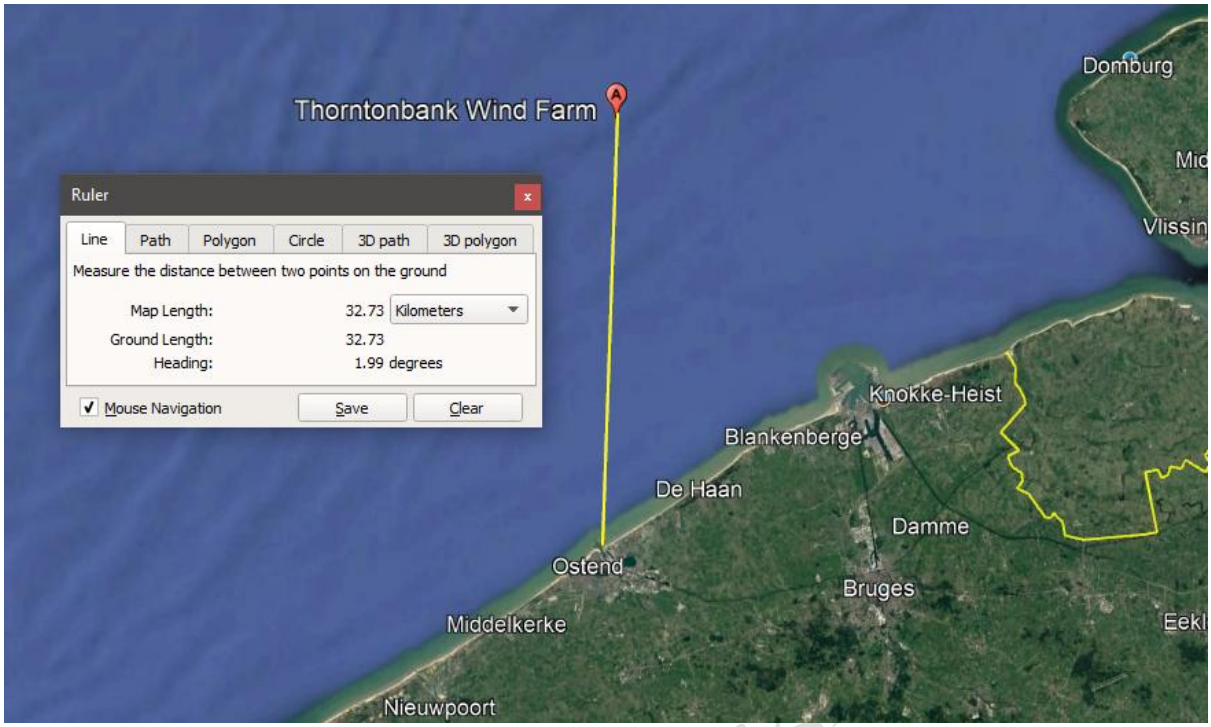
(#036) Thorntonbank Wind Farm (Belgium)

The Thorntonbank Wind Farm is an offshore wind farm located 28 km off the Belgian coast (51° 38′ 39″ N, 2° 55′ 38″ E). The wind turbines are fixed to the seabed at a depth of 12 to 27 meters. The farm was commissioned in 2009 (the rotors have a diameter of 126 meters).

Figure 22 This photo of the offshore wind farm taken on July 14, 2018, off the Belgian coast perfectly shows the curvature of the Earth (author: Lieven, source: Wikipedia)

The situation of the Thorntonbank wind farm is contextualized below:

translation



For the record... in the impact study of the Gulf of Lion floating wind farm available here on the European Investment Bank website:

https://www.eib.org/attachments/registers/125574701.pdf

Les éoliennes flottantes du golfe du Lion
Rte
Le réseau de transport d'électricité
EOLIENNES FLOTTANTES DU GOLFE DU LION
ÉTUDE D'IMPACT
6 - Effets et impacts du projet sur l'environnement et la santé

On page 1099 we have an indication that the curvature of the Earth has been taken into account:

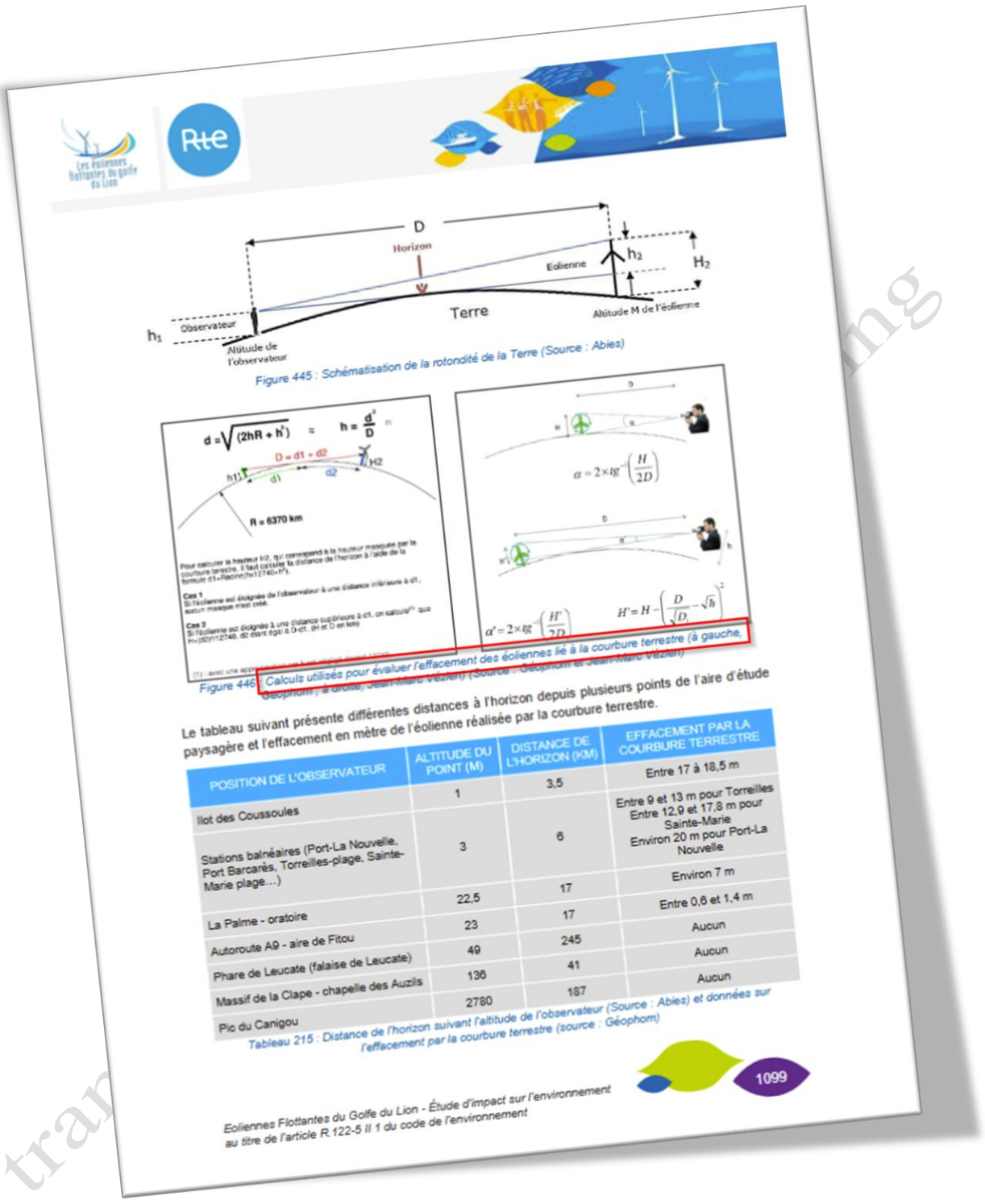


Figure 445 : Schématisation de la rotondité de la Terre (Source : Abies)

Figure 446 : Calculs utilisés pour évaluer l'effacement des éoliennes lié à la courbure terrestre (à gauche, Géophom ; à droite, Jean-Hilaire Vézien) (Source : Géophom et Jean-Hilaire Vézien)

Le tableau suivant présente différentes distances à l'horizon depuis plusieurs points de l'aire d'étude paysagère et l'effacement en mètre de l'éolienne réalisée par la courbure terrestre.

POSITION DE L'OBSERVATEUR	ALTITUDE DU POINT (M)	DISTANCE DE L'HORIZON (KM)	EFFACEMENT PAR LA COURBURE TERRESTRE
Ilot des Coussoules	1	3,5	Entre 17 à 18,5 m
Stations balnéaires (Port-La Nouvelle, Port Barcarès, Torreilles-plage, Sainte-Marie plage…)	3	6	Entre 9 et 13 m pour Torreilles Entre 12,9 et 17,8 m pour Sainte-Marie Environ 20 m pour Port-La Nouvelle
La Palme - oratoire	22,5	17	Environ 7 m
Autoroute A9 - aire de Fitou	23	17	Entre 0,6 et 1,4 m
Phare de Leucate (falaise de Leucate)	49	245	Aucun
Massif de la Clape - chapelle des Auzils	136	41	Aucun
Pic du Canigou	2780	187	Aucun

Tableau 215 : Distance de l'horizon suivant l'altitude de l'observateur (Source : Abies) et données sur l'effacement par la courbure terrestre (source : Géophom)

Where it is written: "*Calculations used to assess the erasure of wind turbines linked to the curvature of the Earth…*"

(#037) Santa Barbara oil platforms (United States)

We can clearly see that among the seven oil platforms of Santa Barbara in California (USA - 34°19’53.61"N, 119°36’16.89"W) below, those in the background end up disappearing below the horizon because the Earth is curved:

Figure 23 Two Pacific white-sided dolphins race toward the viewer, away from seven oil derricks behind them in the Santa Barbara Channel

translation in

(#038) Ocean Monarch oil platform (Australia)

The Ocean Monarch oil platform was currently in Australia in December 2017. Here are its technical specifications:

Name	**OCEAN MONARCH**
Vessel type	**Oil service / Platform**
IMO	**8751368**
MMSI	**538002469**
Callsign	**V7IY3**
Flag	**Marshall Islands**
Year built	**1974**
Length overall (LOA)	**70 meters**
Width (beam)	**71 meters**

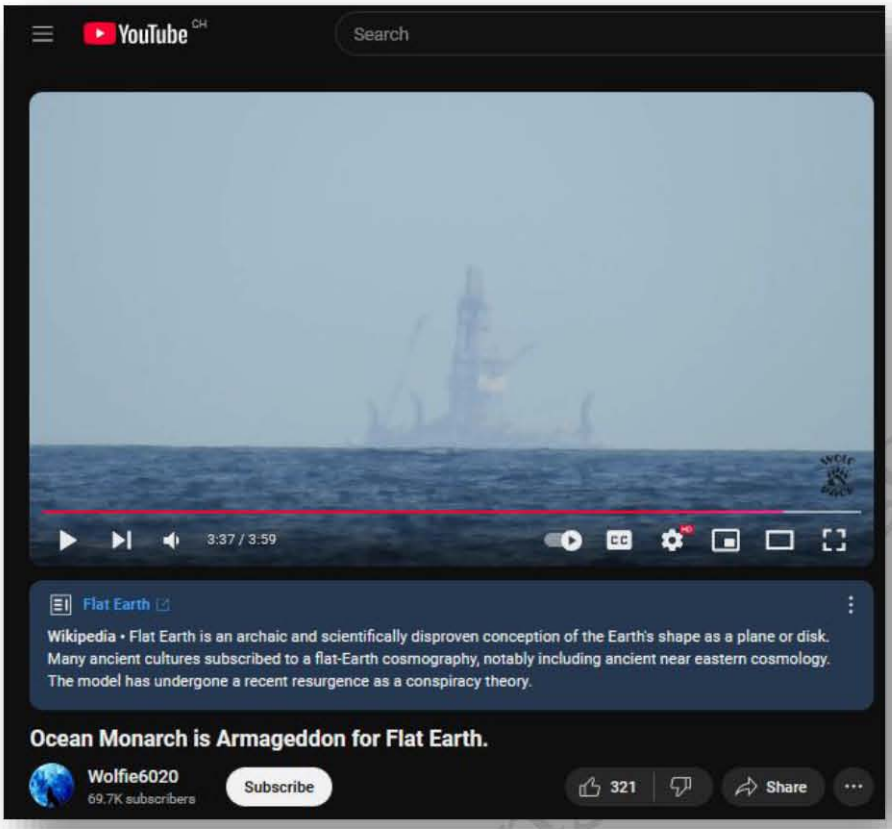
From City Beach (Australia, 31.9271° S, 115.7659° E), the bottom of the platform is clearly visible:

And further from Mindiari the base is no longer visible:

And that's because the Earth is curved!

The original video is available here:

https://www.youtube.com/watch?v=BdYvqPMVA0c


YouTube CH
Search
3:37 / 3:59
Flat Earth
Wikipedia • Flat Earth is an archaic and scientifically disproven conception of the Earth's shape as a plane or disk. Many ancient cultures subscribed to a flat-Earth cosmography, notably including ancient near eastern cosmology. The model has undergone a recent resurgence as a conspiracy theory.
Ocean Monarch is Armageddon for Flat Earth.
Wolfie6020
69.7K subscribers
Subscribe
321
Share

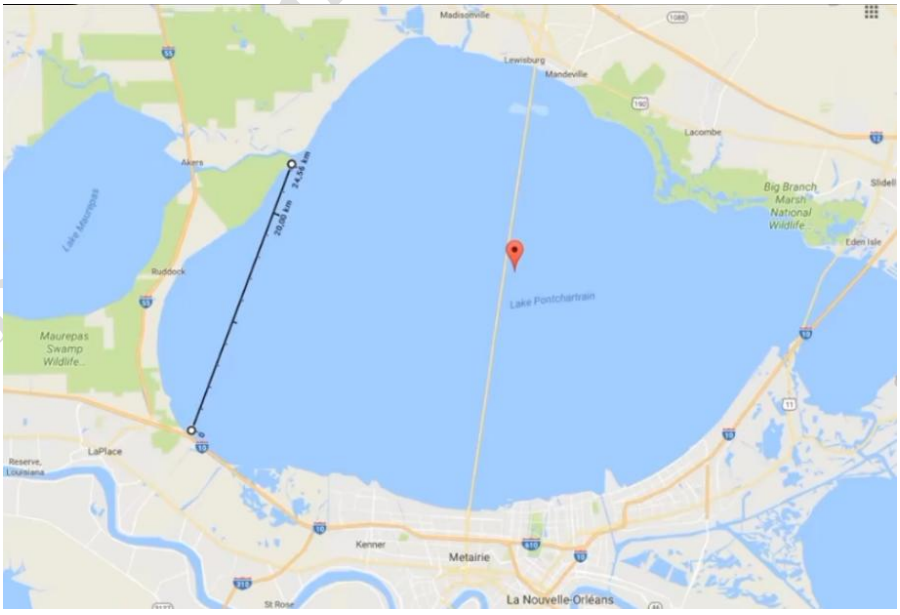
translation into en ing

(#039) Pontchartrain High Voltage Power Line (United States)

The high-voltage power line of 85 electric pylons over 24.27 km that crosses Lake Pontchartrain, just next to New Orleans in the United States, clearly shows the curvature of the Earth:

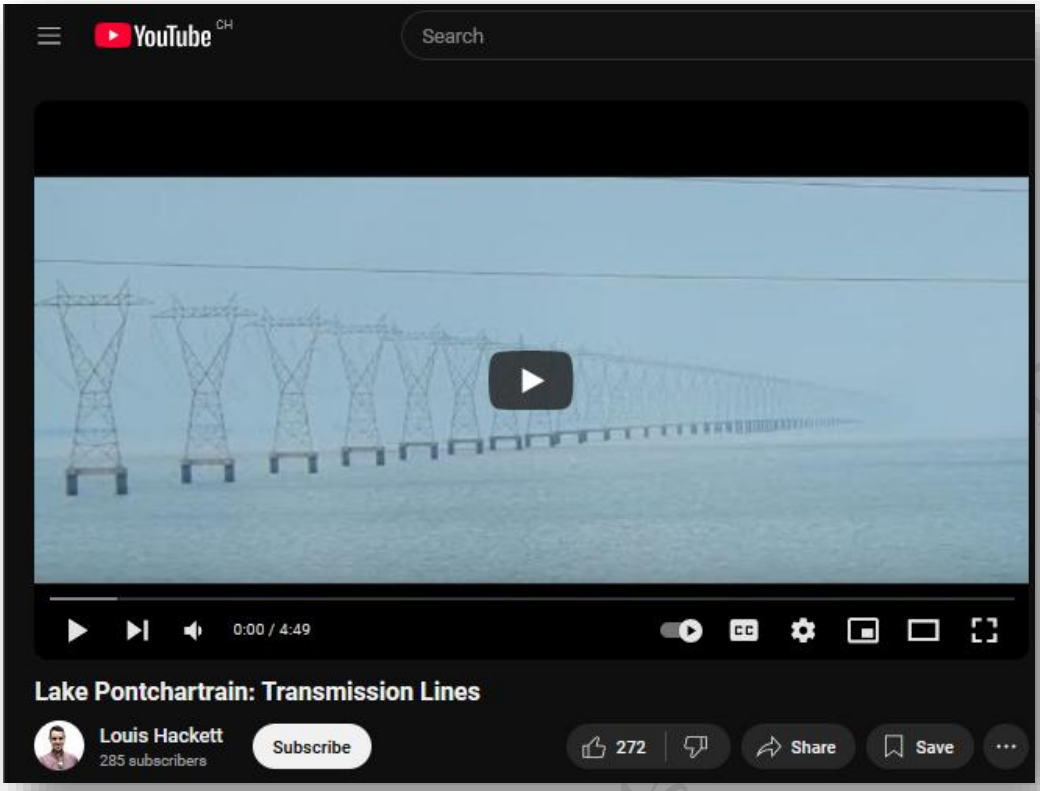
Figure 24 High voltage power line at Pontchartrain

For context (the power line is the black line on the left and the Pontchartrain Bridge is the yellow line):

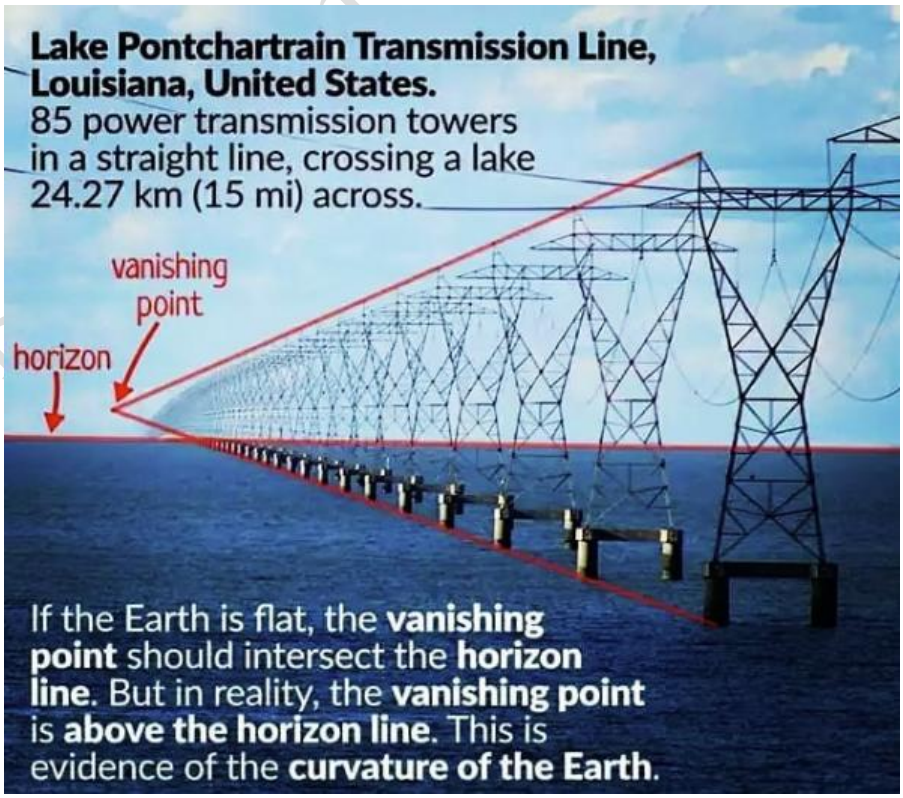


A YouTube video is also available here:

https://www.youtube.com/watch?v=hSaVN_TxqKM



The fact that the vanishing point is above the Earth line (commonly called the "horizon") is further proof that the Earth is not flat (!):


Lake Pontchartrain Transmission Line, Louisiana, United States.
85 power transmission towers in a straight line, crossing a lake 24.27 km (15 mi) across.
vanishing point
horizon
If the Earth is flat, the vanishing point should intersect the horizon line. But in reality, the vanishing point is above the horizon line. This is evidence of the curvature of the Earth.

(#040) Verrazzano-Narrows Bridge (United States)

The Verrazzano-Narrows Bridge in New York City is a well-known example where the Earth's curvature is measured and taken into account. With a central span of 1,298 meters, it was the longest suspension bridge in the world when it was built in 1964. Its two suspension towers are 211 meters high and 1,298 meters apart. Although each tower is vertical and perpendicular to the water, they are 41.28 millimeters farther apart at the top than at the bottom. This is due to the Earth's curvature, as illustrated below:

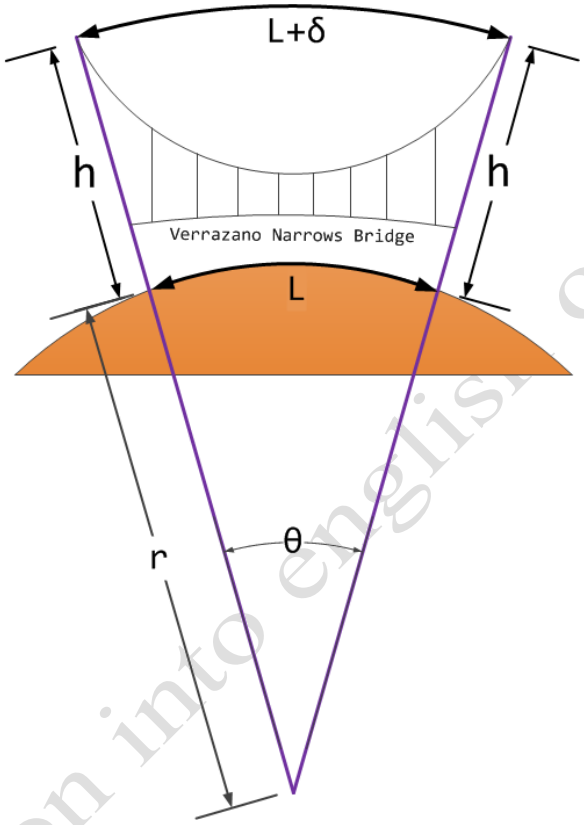


Figure 25 (Exaggerated) illustration of the Earth's curvature on a cable-stayed bridge (source: Math Encounters Blog)

With obviously:

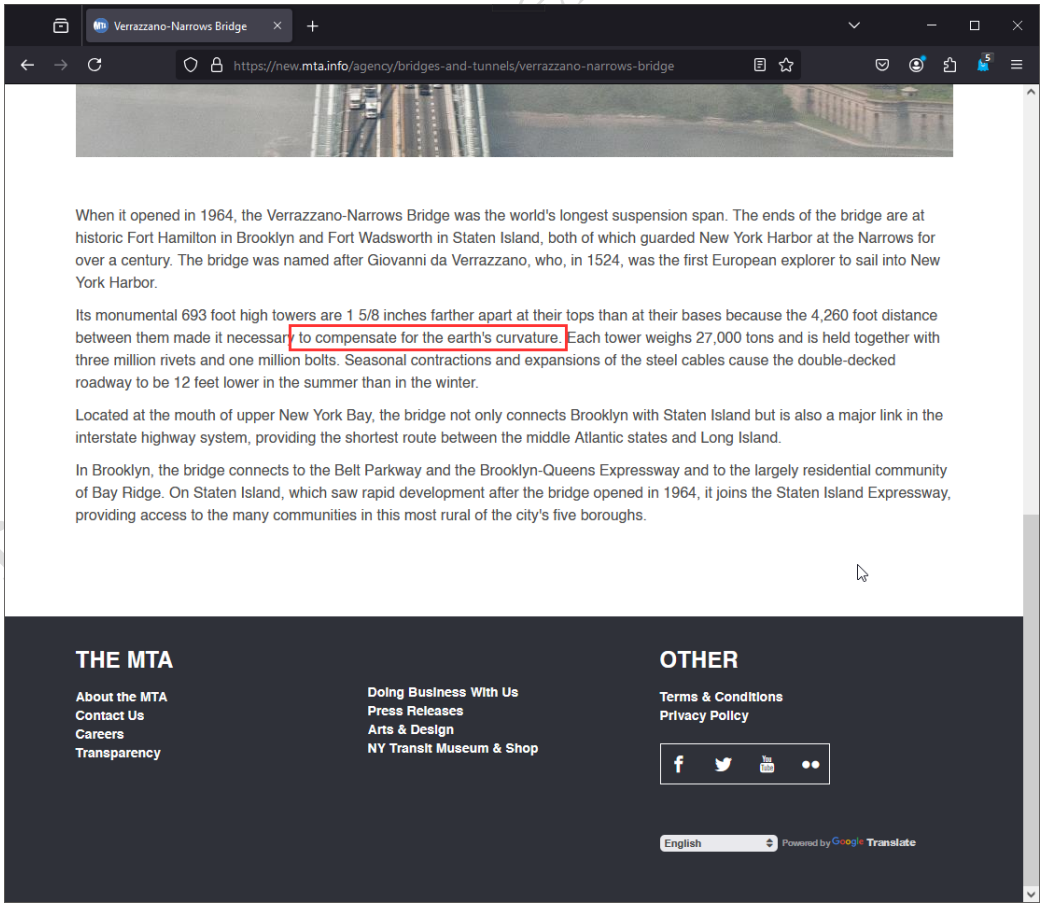
$$\delta = (r + h) \cdot \theta - L$$

translation into english ongoing

Figure 26 Verrazon-Narrows Bridge (author: Ajay Suresh, source: Wikipedia)

The company that manages the bridge's maintenance (MTA: Metropolitan Transportation Authority) confirms the distance on its website:

https://new.mta.info/agency/bridges-and-tunnels/verrazzano-narrows-bridge


Verrazzano-Narrows Bridge
https://new.mta.info/agency/bridges-and-tunnels/verrazzano-narrows-bridge
When it opened in 1964, the Verrazzano-Narrows Bridge was the world's longest suspension span. The ends of the bridge are at historic Fort Hamilton in Brooklyn and Fort Wadsworth in Staten Island, both of which guarded New York Harbor at the Narrows for over a century. The bridge was named after Giovanni da Verrazzano, who, in 1524, was the first European explorer to sail into New York Harbor.
Its monumental 693 foot high towers are 1 5/8 inches farther apart at their tops than at their bases because the 4,260 foot distance between them made it necessary to compensate for the earth's curvature. Each tower weighs 27,000 tons and is held together with three million rivets and one million bolts. Seasonal contractions and expansions of the steel cables cause the double-decked roadway to be 12 feet lower in the summer than in the winter.
Located at the mouth of upper New York Bay, the bridge not only connects Brooklyn with Staten Island but is also a major link in the interstate highway system, providing the shortest route between the middle Atlantic states and Long Island.
In Brooklyn, the bridge connects to the Belt Parkway and the Brooklyn-Queens Expressway and to the largely residential community of Bay Ridge. On Staten Island, which saw rapid development after the bridge opened in 1964, it joins the Staten Island Expressway, providing access to the many communities in this most rural of the city's five boroughs.
THE MTA
About the MTA
Contact Us
Careers
Transparency
Doing Business With Us
Press Releases
Arts & Design
NY Transit Museum & Shop
OTHER
Terms & Conditions
Privacy Policy
English
Powered by Google Translate

(#041) Humber Bridge (England)

The Humber Bridge in Barton-upon-Humber (UK) is a well-known example where the curvature of the Earth is measured and taken into account. With a central span of 2,200 meters, it was the longest suspension bridge in the world between 1981 and 1998. Its two suspension towers are 155.5 meters high and 2,200 meters apart. Although each tower is vertical and perpendicular to the water, they are 36 millimeters further apart at the top than at the bottom. This is due to the curvature of the Earth, as illustrated below:

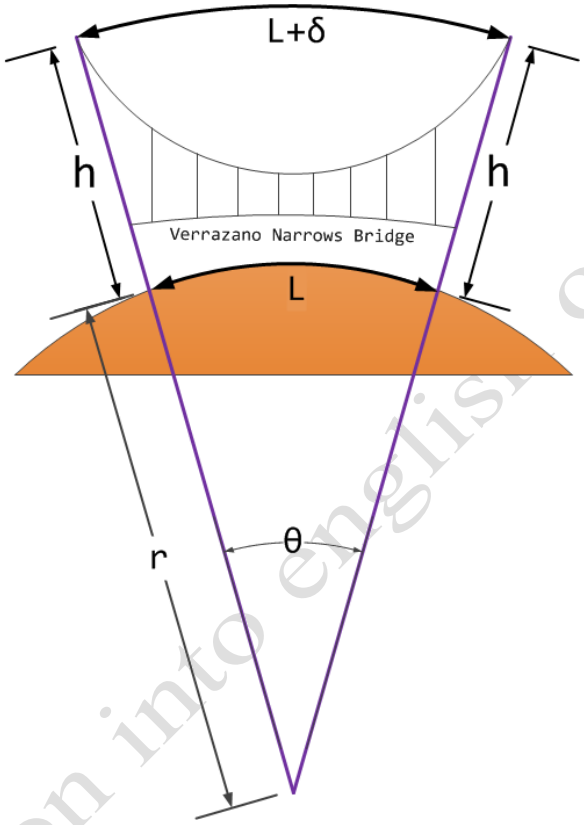


Figure 27 (Exaggerated) illustration of the Earth's curvature on a cable-stayed bridge (source: Math Encounters Blog)

With obviously:

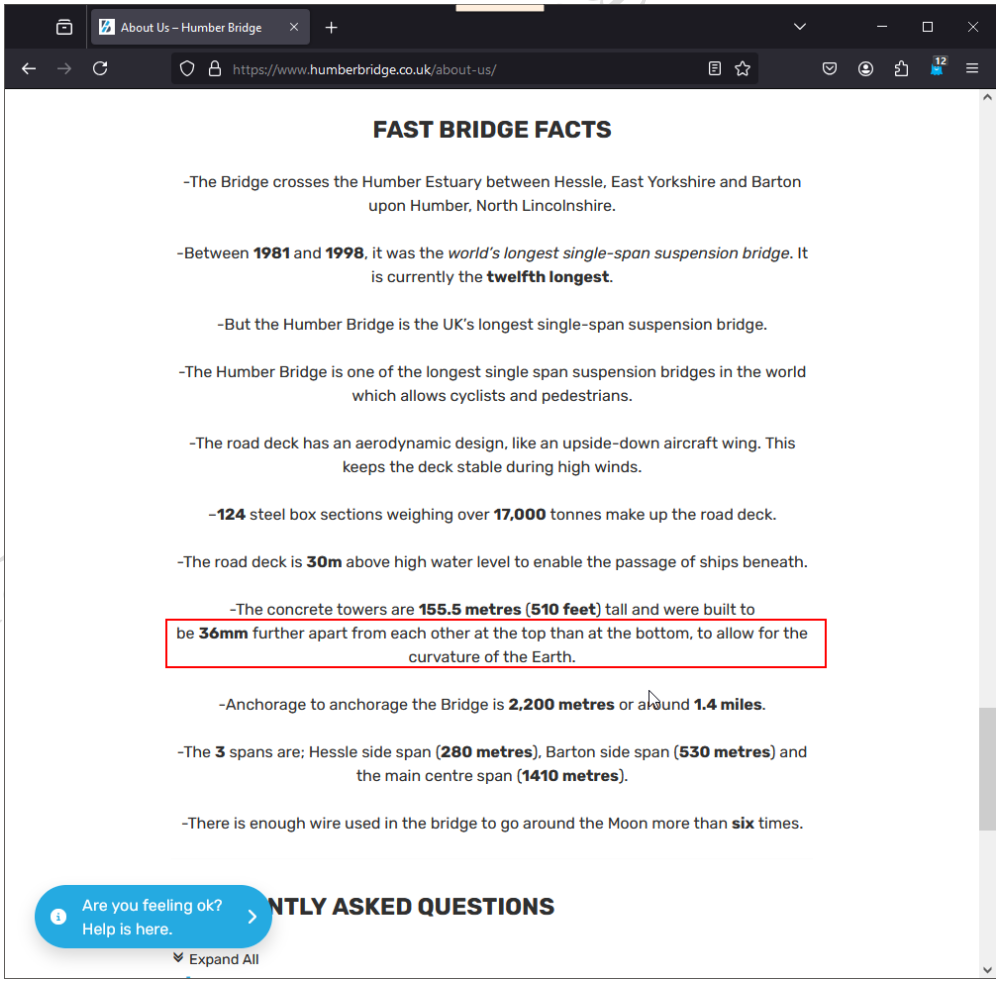
$$\delta = (r + h) \cdot \theta - L$$

translation into english ongoing

Figure 28 Humber Bridge

The company that manages the maintenance of the bridge confirms the distance on its website:

https://www.humberbridge.co.uk/about-us/


About Us – Humber Bridge
https://www.humberbridge.co.uk/about-us/
FAST BRIDGE FACTS
-The Bridge crosses the Humber Estuary between Hessle, East Yorkshire and Barton upon Humber, North Lincolnshire.
-Between 1981 and 1998, it was the world's longest single-span suspension bridge. It is currently the twelfth longest.
-But the Humber Bridge is the UK's longest single-span suspension bridge.
-The Humber Bridge is one of the longest single span suspension bridges in the world which allows cyclists and pedestrians.
-The road deck has an aerodynamic design, like an upside-down aircraft wing. This keeps the deck stable during high winds.
-124 steel box sections weighing over 17,000 tonnes make up the road deck.
-The road deck is 30m above high water level to enable the passage of ships beneath.
-The concrete towers are 155.5 metres (510 feet) tall and were built to be 36mm further apart from each other at the top than at the bottom, to allow for the curvature of the Earth.
-Anchorage to anchorage the Bridge is 2,200 metres or around 1.4 miles.
-The 3 spans are; Hessle side span (280 metres), Barton side span (530 metres) and the main centre span (1410 metres).
-There is enough wire used in the bridge to go around the Moon more than six times.
Are you feeling ok? Help is here.
NTLY ASKED QUESTIONS
Expand All

(#042) Akahsi Kaikyo Bridge (Japan)

The Akashi Strait Bridge (明石海峡大橋, Akashi Kaikyō Ōhashi) is a suspension bridge located in Japan. It spans the Seto Inland Sea, connecting Kobe on the main island of Honshu to Awaji Island. Its central span is 1,991 meters long. The total length of the bridge is 3,911 meters, making it the second longest suspension bridge in the world. This bridge is the final link in a network connecting the four main islands of Japan: Honshu, Hokkaido, Kyushu, and Shikoku.

Figure 29 Akashi Strait Bridge (source : Wikipédia, auteur : H.Oomor)

As evidenced by an original project document in Japanese, which is available at the following link on the bridge builder's website:

https://www.kawada.co.jp/technology/gihou/pdf/vol17/17_ron_12.pdf

translation

論文・報告

明石海峡大橋補剛桁の設計・製作・架設

～本州四国連絡橋公団　「神戸・淡路・鳴門ルート」～

The Design, Fabrication and Construction of the AKASHI KAIKYO Bridge Stiffening Truss

金田　高康
Takayasu KANEDA

山田　秀美
Hidemi YAMADA

金野　千代美
Chiyomi KONNO

内海　靖
Yasushi UCHIUMI

和田　浩介
Kosuke WADA

大江　慎一
Shin-ichi OHE

When complete the Akashi Kaikyo Bridge, a 3-span, 2-hinged stiffening truss suspension bridge, will span the Akashi Straits. The bridge will link Honshu, the main island of Japan, with the island of Awaji and will be 3910 m long with a center span (tower to tower) of 1990 m.
This report describes the design, fabrication and erection for the bridge.
Key words : Akashi Kaikyo Bridge, suspension bridge, stiffening truss

1．はじめに

明石海峡大橋（図1）は，本州四国連絡橋「神戸・淡路・鳴門ルート」に属し，海象・気象条件が厳しく，航行船舶が極めて多い明石海峡を横断し神戸市垂水区舞子と淡路島側の津名郡淡路町との間を結ぶ，橋長3 910m，中央径間長1 990mの3径間2ヒンジ補剛トラス吊橋で道路単独橋である。明石海峡大橋は，現在，世界最長の英国のハンバー橋（中央径間長1 410m）より580m長く，完成時には世界最長の吊橋となる。

明石海峡大橋補剛桁工事は，本州四国連絡橋公団より平成5年8月にその1工事－その4工事までの4工事区の20社で受注した。当社は，川田・日立・瀧上・高田・片山特定建設工事企業体として3P～4A間の淡路側補剛桁（その4工事）を受注し，補剛桁の実施設計，製作ならびに架設を行った。

本文は，補剛桁工事の実施設計，製作および架設の概要とPWSハンガー定着部の設計・製作とハンガー引き込み方法について報告するものである。

2．実施設計

明石海峡大橋補剛桁の実施設計については数多く報告[1]-[3]されているので，本文では実施設計の概要とPWSハンガー定着部の概要について述べる。

本橋の主要諸元を**表1**に，補剛桁の標準断面図を**図2**に示す。また，補剛桁の鋼重は，補剛トラス，道路床組，管理路および公共添架物（関西電力，淡路広域水道，NTTおよび展望施設）を含めて約89 200トンである。

(1) **実施設計の概要**

a）基本構造

① 補剛桁の形式は，耐風安定性，施工条件，経済性など数々の面から検討された結果，補剛桁として実績の

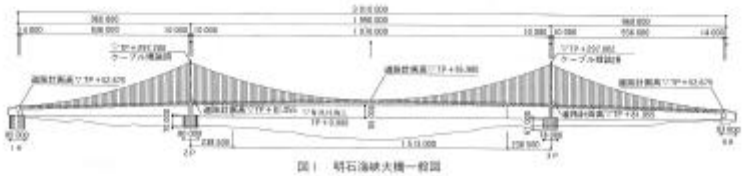


図1　明石海峡大橋一般図

on page 2, we have the following passage:

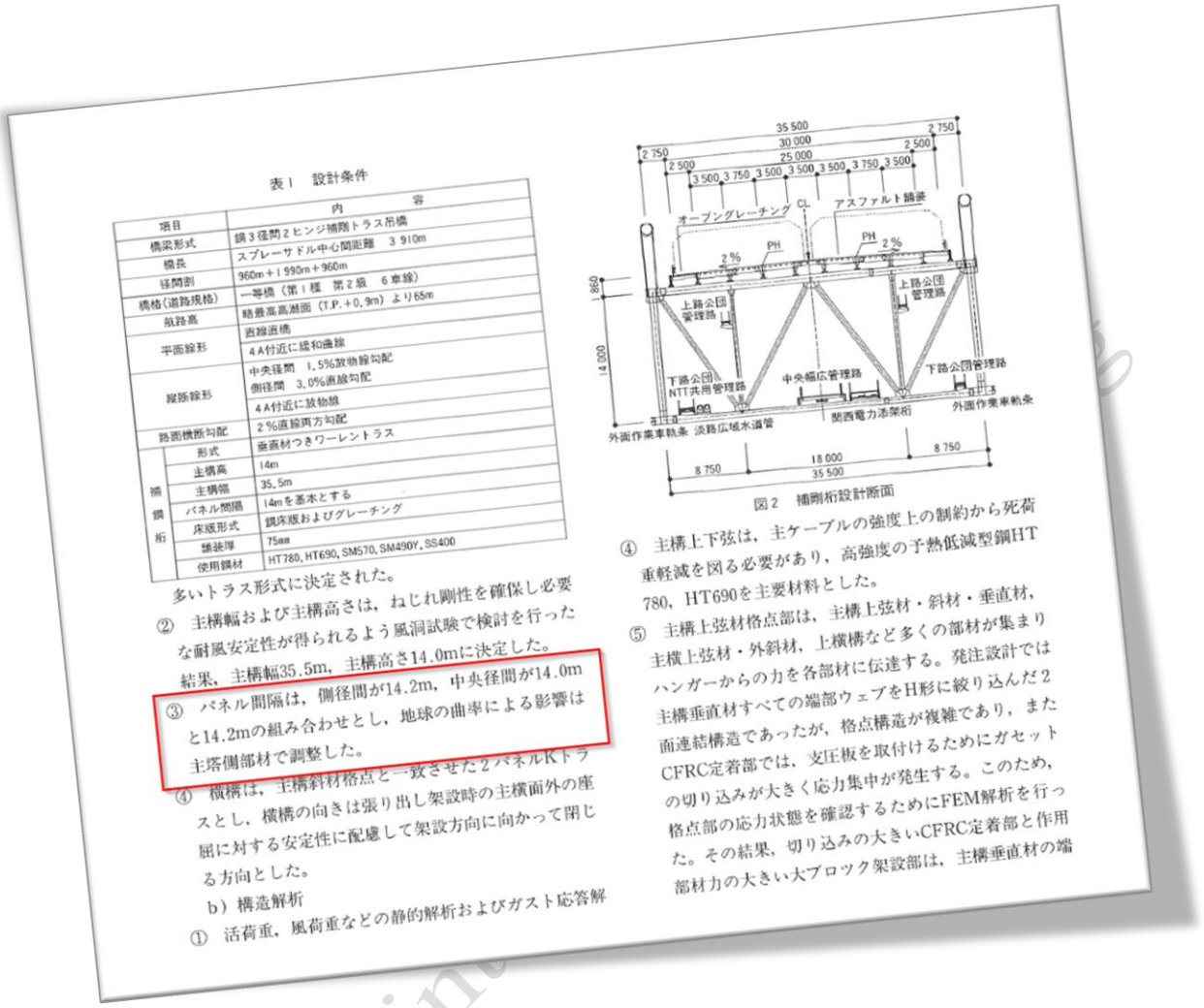


表1　設計条件

項目	内容
橋梁形式	鋼3径間2ヒンジ補剛トラス吊橋
橋長	スプレーサドル中心間距離　3 910m
径間割	960m＋1 990m＋960m
橋格（道路規格）	一等橋（第1種　第2級　6車線）
航路高	暗最高高潮面（T.P.＋0.9m）より65m
平面線形	直線直橋
縦断線形	4A付近に緩和曲線 中央径間　1.5%放物線勾配 側径間　3.0%直線勾配 4A付近に放物線
路面横断勾配	2%直線両方勾配
補剛桁 形式	垂直材つきワーレントラス
補剛桁 主構高	14m
補剛桁 主構幅	35.5m
補剛桁 パネル間隔	14mを基本とする
補剛桁 床版形式	鋼床版およびグレーチング
補剛桁 舗装厚	75mm
補剛桁 使用鋼材	HT780, HT690, SM570, SM490Y, SS400

多いトラス形式に決定された。

② 主構幅および主構高さは，ねじれ剛性を確保し必要な耐風安定性が得られるよう風洞試験で検討を行った結果，主構幅35.5m，主構高さ14.0mに決定した。

③ パネル間隔は，側径間が14.2m，中央径間が14.0mと14.2mの組み合わせとし，地球の曲率による影響は主塔側部材で調整した。

④ 横構は，主構斜材格点と一致させた2パネルKトラスとし，横構の向きは張り出し架設時の主横面外の座屈に対する安定性に配慮して架設方向に向かって閉じる方向とした。

b）構造解析

① 活荷重，風荷重などの静的解析およびガスト応答解

図2　補剛桁設計断面

④ 主構上下弦は，主ケーブルの強度上の制約から死荷重軽減を図る必要があり，高強度の予熱低減型鋼HT780，HT690を主要材料とした。

⑤ 主構上弦材格点部は，主構上弦材・斜材・垂直材，主横上弦材・外斜材，上横構など多くの部材が集まりハンガーからの力を各部材に伝達する。発注設計では主構垂直材すべての端部ウェブをH形に絞り込んだ2面連結構造であったが，格点構造が複雑であり，またCFRC定着部では，支圧板を取付けるためにガセットの切り込みが大きく応力集中が発生する。このため，格点部の応力状態を確認するためにFEM解析を行った。その結果，切り込みの大きいCFRC定着部と作用部材力の大きい大ブロック架設部は，主構垂直材の端

translation in progress

Translated into English, it reads: "*The panel spacing is a combination of 14.2 m for the side spans and 14.0 m for the central span, and the effects of the Earth's curvature are adjusted using elements of the main tower.*"

The engineers therefore had indeed to take into account the curvature of the Earth!

(#043) David Taylor's Modeling Basin (United States)

The David Taylor Modeling Basin (DTMB) is one of the world's largest ship modeling basins, built in 1985 in Maryland/Washington DC (USA), a testing facility for ship design development with a length of 574.85 meters. The DTMB is a field activity of the Naval Surface Warfare Center's Carderock Division.

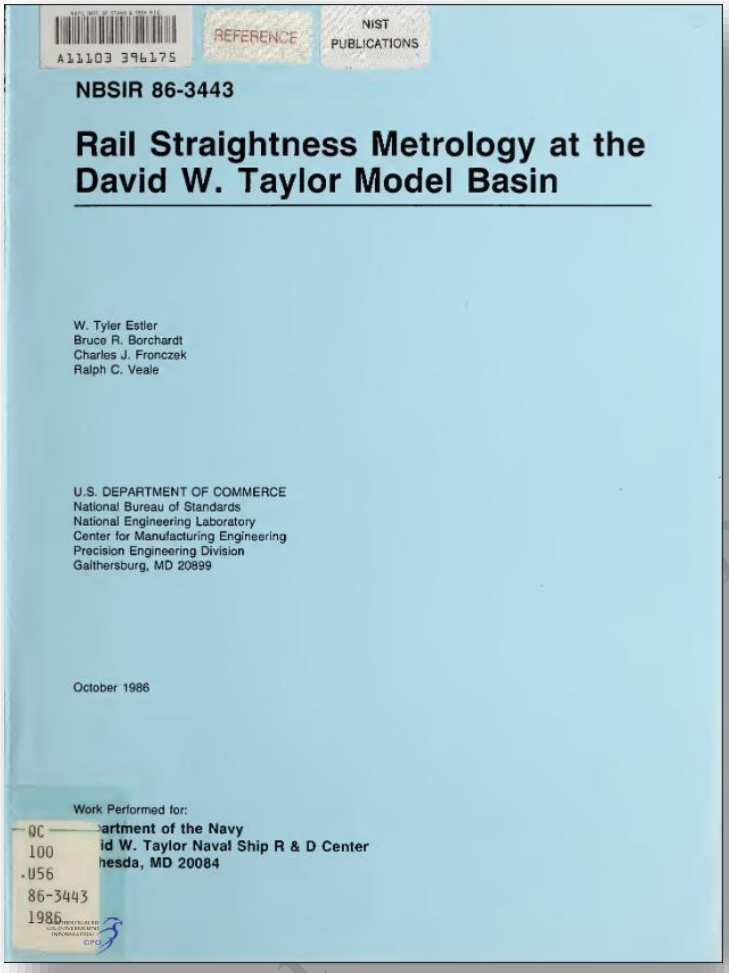
Figure 30 David Taylor's Modeling Basin in Maryland / Washington DC (USA)

Here is an internal view:

translation

In the report on the structure of the basin rails available here:

https://www.govinfo.gov/content/pkg/GOVPUB-C13-7a1b508661013978a071cc02a023995d/pdf/GOVPUB-C13-7a1b508661013978a071cc02a023995d.pdf



A11103 396175

REFERENCE

NIST PUBLICATIONS

NBSIR 86-3443

Rail Straightness Metrology at the David W. Taylor Model Basin

W. Tyler Estler
Bruce R. Borchardt
Charles J. Fronczek
Ralph C. Veale

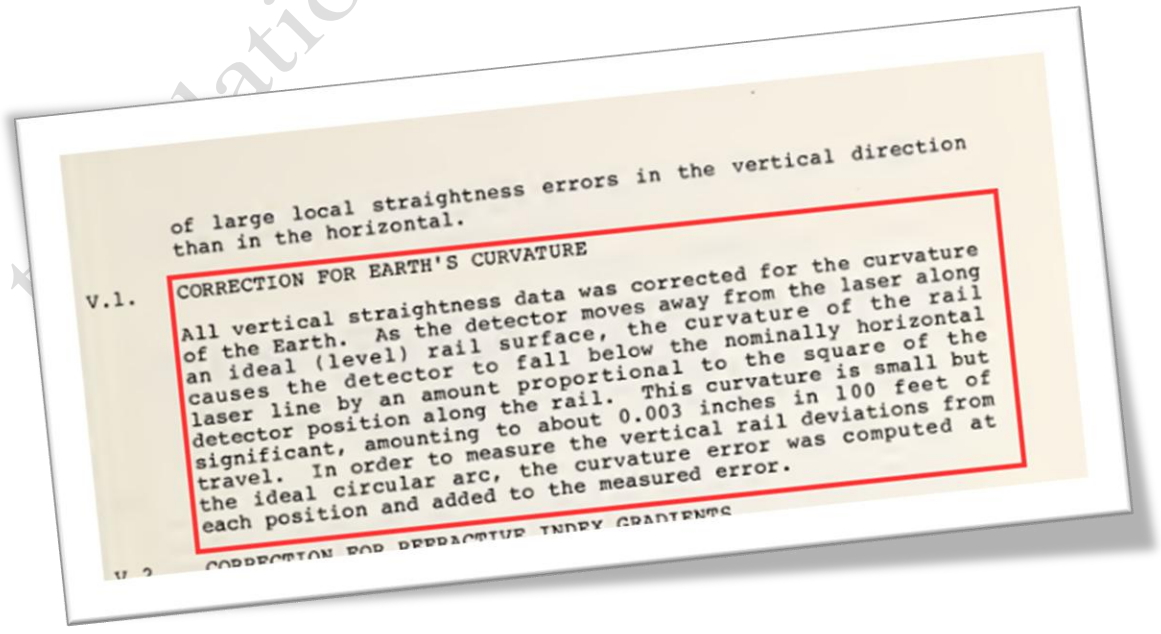
U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
National Engineering Laboratory
Center for Manufacturing Engineering
Precision Engineering Division
Gaithersburg, MD 20899

October 1986

Work Performed for:
artment of the Navy
id W. Taylor Naval Ship R & D Center
hesda, MD 20084

QC
100
.U56
86-3443
1986

And we have the following passage on page 7 which indicates that the curvature of the Earth had to be taken into account:



of large local straightness errors in the vertical direction than in the horizontal.

V.1. CORRECTION FOR EARTH'S CURVATURE

All vertical straightness data was corrected for the curvature of the Earth. As the detector moves away from the laser along an ideal (level) rail surface, the curvature of the rail causes the detector to fall below the nominally horizontal laser line by an amount proportional to the square of the detector position along the rail. This curvature is small but significant, amounting to about 0.003 inches in 100 feet of travel. In order to measure the vertical rail deviations from the ideal circular arc, the curvature error was computed at each position and added to the measured error.

V.2 CORRECTION FOR REFRACTIVE INDEX GRADIENTS

(#044) University of Southampton Modeling Basin (United States)

The University of Southampton (England) hydro-science facility houses a 138 meters towing and wave basin, two large wind tunnels and flumes:

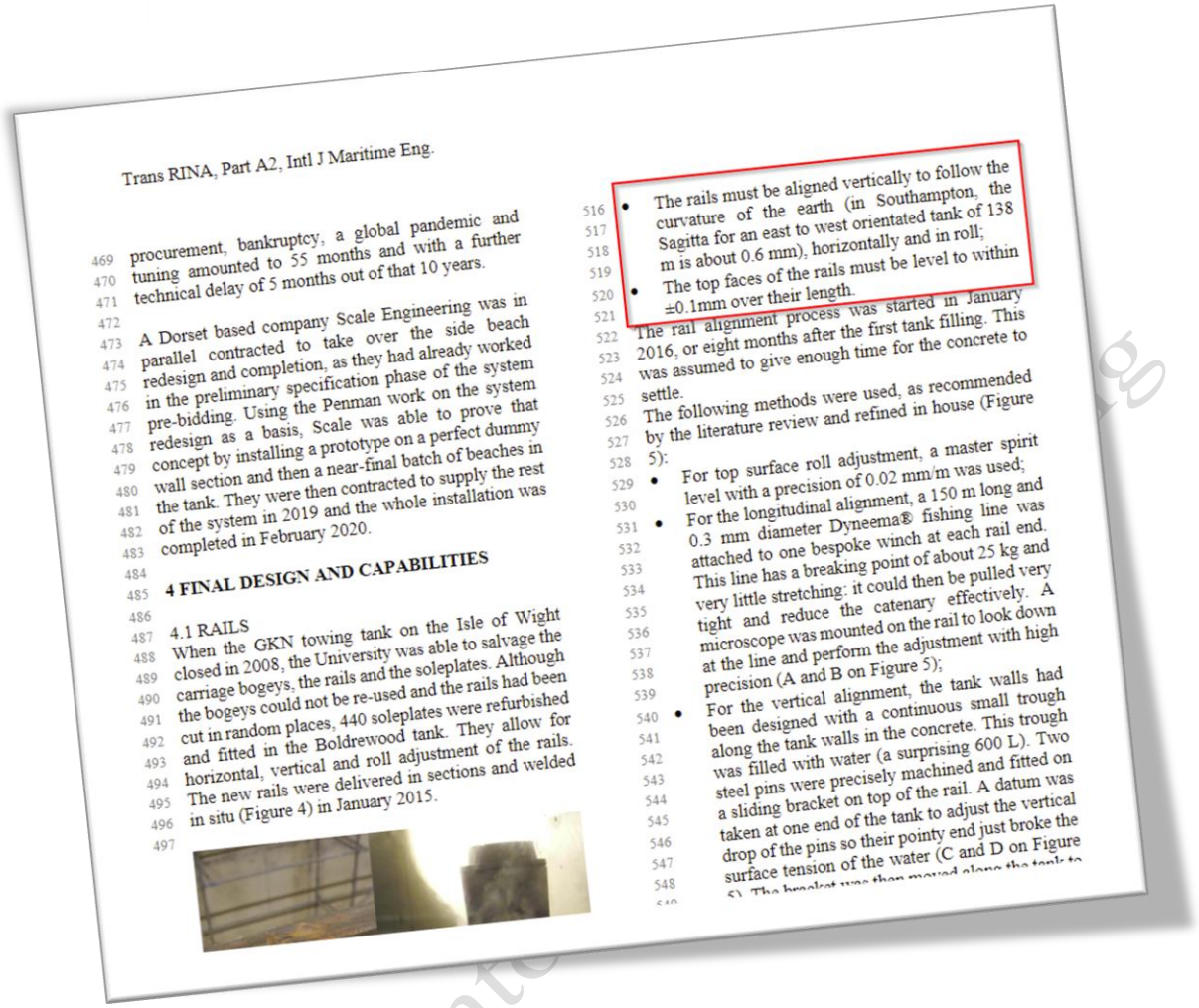
Figure 31 Southampton Hydro-Scientific facility (© Jim Stephenson)

The specification required the top faces of the rails to be level to within ±0.1 mm along their length (138 meters), but the curvature of the Earth over this distance is about 0.6 mm.

In their technical document available here:

https://eprints.soton.ac.uk/489501/1/BoldrewoodTank_accepted.pdf

We have on page 6:



Trans RINA, Part A2, Intl J Maritime Eng.

procurement, bankruptcy, a global pandemic and tuning amounted to 55 months and with a further technical delay of 5 months out of that 10 years.

A Dorset based company Scale Engineering was in parallel contracted to take over the side beach redesign and completion, as they had already worked in the preliminary specification phase of the system pre-bidding. Using the Penman work on the system redesign as a basis, Scale was able to prove that concept by installing a prototype on a perfect dummy wall section and then a near-final batch of beaches in the tank. They were then contracted to supply the rest of the system in 2019 and the whole installation was completed in February 2020.

4 FINAL DESIGN AND CAPABILITIES

4.1 RAILS

When the GKN towing tank on the Isle of Wight closed in 2008, the University was able to salvage the carriage bogeys, the rails and the soleplates. Although the bogeys could not be re-used and the rails had been cut in random places, 440 soleplates were refurbished and fitted in the Boldrewood tank. They allow for horizontal, vertical and roll adjustment of the rails. The new rails were delivered in sections and welded in situ (Figure 4) in January 2015.

- The rails must be aligned vertically to follow the curvature of the earth (in Southampton, the Sagitta for an east to west orientated tank of 138 m is about 0.6 mm), horizontally and in roll;
- The top faces of the rails must be level to within ±0.1mm over their length.

The rail alignment process was started in January 2016, or eight months after the first tank filling. This was assumed to give enough time for the concrete to settle.

The following methods were used, as recommended by the literature review and refined in house (Figure 5):

- For top surface roll adjustment, a master spirit level with a precision of 0.02 mm/m was used;
- For the longitudinal alignment, a 150 m long and 0.3 mm diameter Dyneema® fishing line was attached to one bespoke winch at each rail end. This line has a breaking point of about 25 kg and very little stretching: it could then be pulled very tight and reduce the catenary effectively. A microscope was mounted on the rail to look down at the line and perform the adjustment with high precision (A and B on Figure 5);
- For the vertical alignment, the tank walls had been designed with a continuous small trough along the tank walls in the concrete. This trough was filled with water (a surprising 600 L). Two steel pins were precisely machined and fitted on a sliding bracket on top of the rail. A datum was taken at one end of the tank to adjust the vertical drop of the pins so their pointy end just broke the surface tension of the water (C and D on Figure

translation into

Oh and by the way in France…:

https://www.navalnews.com/naval-news/2019/11/dga-hydrodynamics-largest-test-facility-in-europe-part-2/

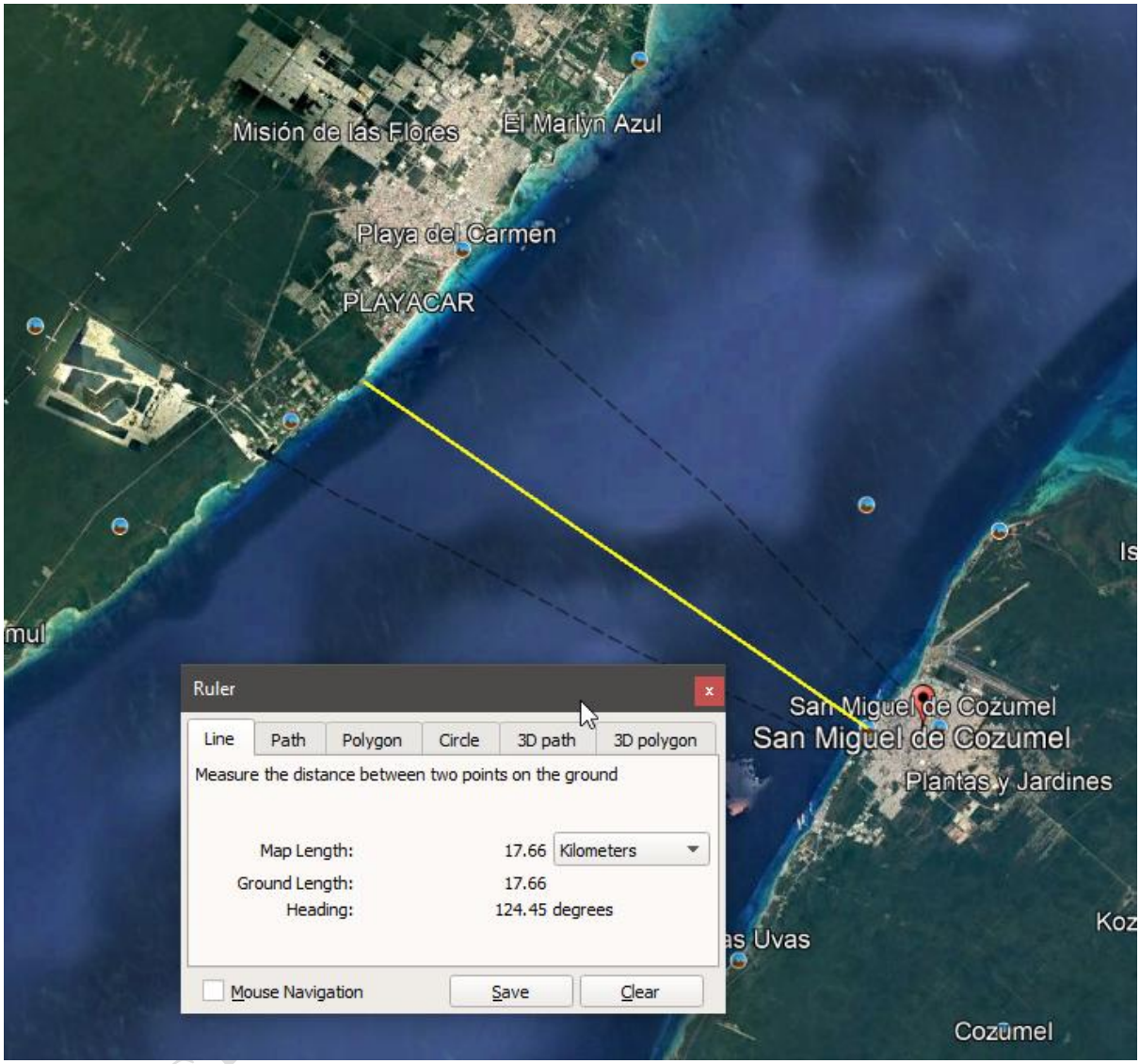
There are three main physical testing facilities in the DGA Hydrodynamics at Val-de-Reuil. But the center is much more than a massive testing equipment, as the research made by the DGA-TH are increasingly based on digital simulation, but also on the Franco-British co-operation.

The building which houses the B600 is more than 600m long. The rails that support the 120t moving platform had to be designed while taking account of the curvature of the Earth for a proper alignment !

translatio
going

(#045) Playa del Carmen/Cozumel (Mexico)

From Playa del Carmen/Mexico (20°37’32.50"N, 87° 4’19.05"W) to Cozumel/Mexico (20°29’41.62"N, 86°57’33.22"W) the hotels appear clearly below the horizon. For context:



And we have:

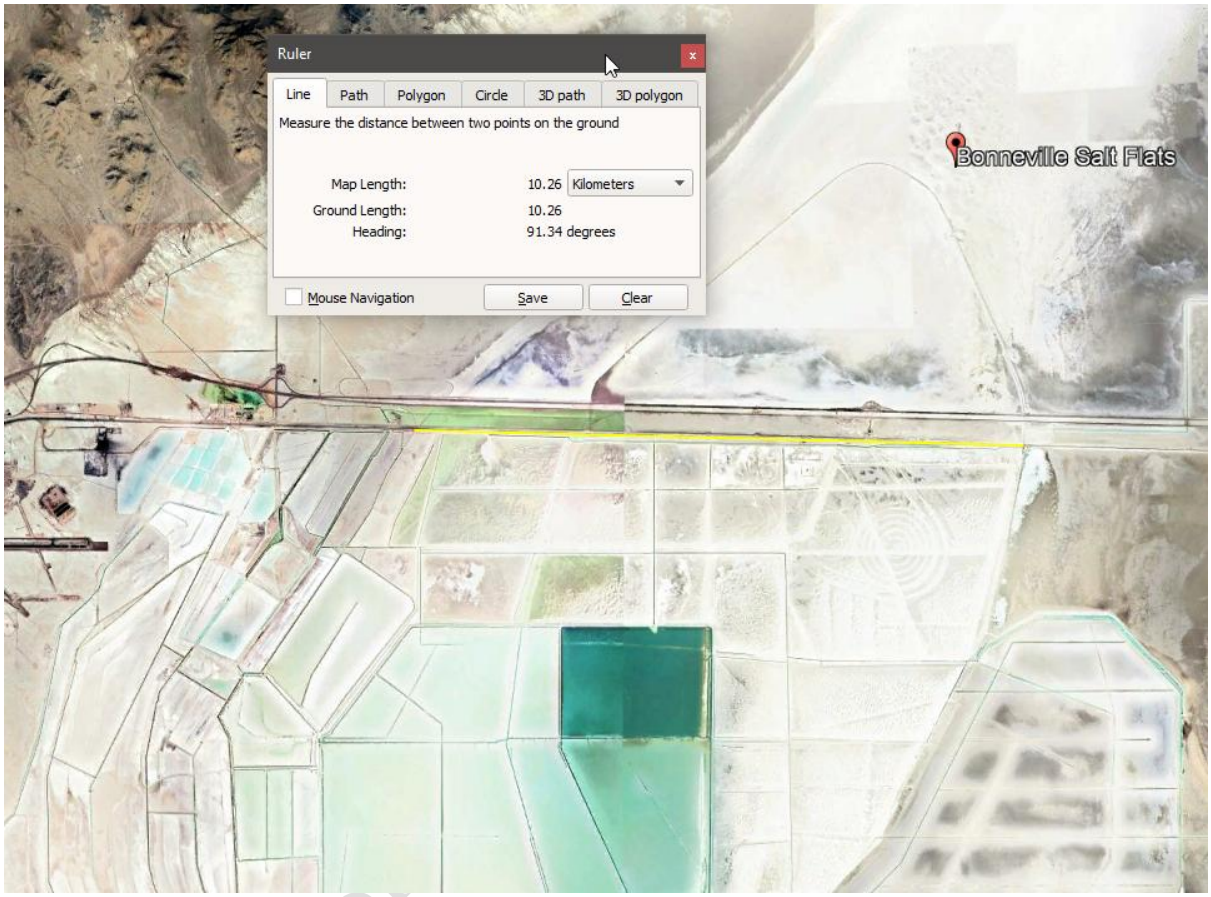
Figure 32 Cozumel Island from Playa Del Carmen, Mexico, and a view from the open sea (author: ?)

You can see other videos from the same location with a macro zoom that proves that the Earth is not flat:

https://www.tiktok.com/@christian_avalos_antitp/video/7358536309457063173

(#046) Bonneville Salt Flats (United States)

The Bonneville Salt Flats is a 260 km^2 salt-covered plain in northwestern Utah, United States. It was formed by the evaporation of Lake Bonneville after the last ice age. It is the largest of several salt flats west of the Great Salt Lake, and the salt is as thick as 1.8 meters in several places.



The surface is level since it comes from the evaporation of an ancient salt lake:

translation

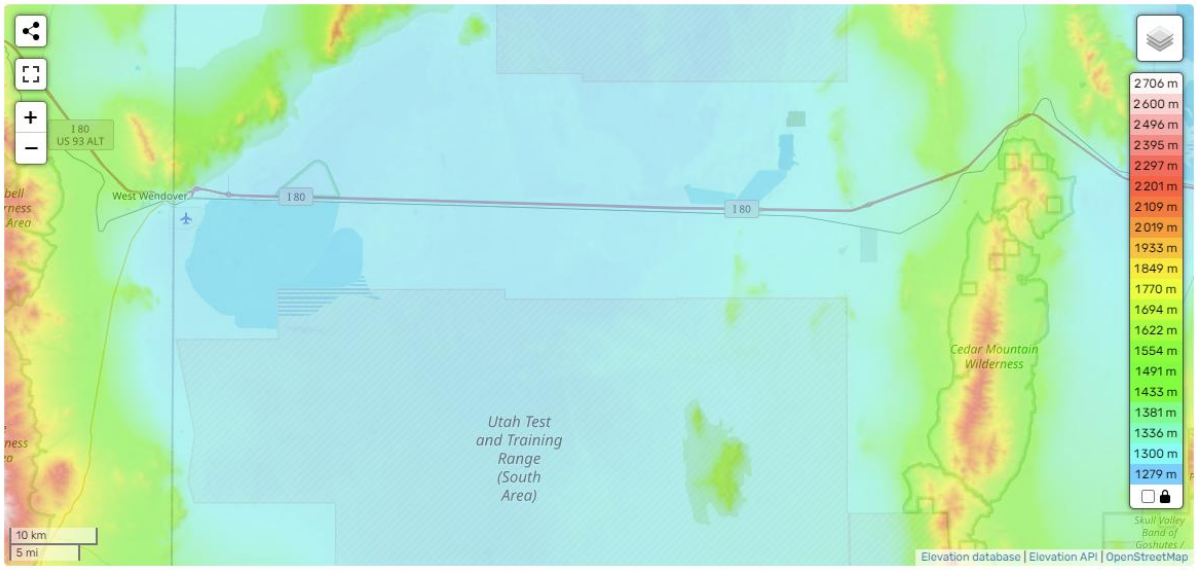
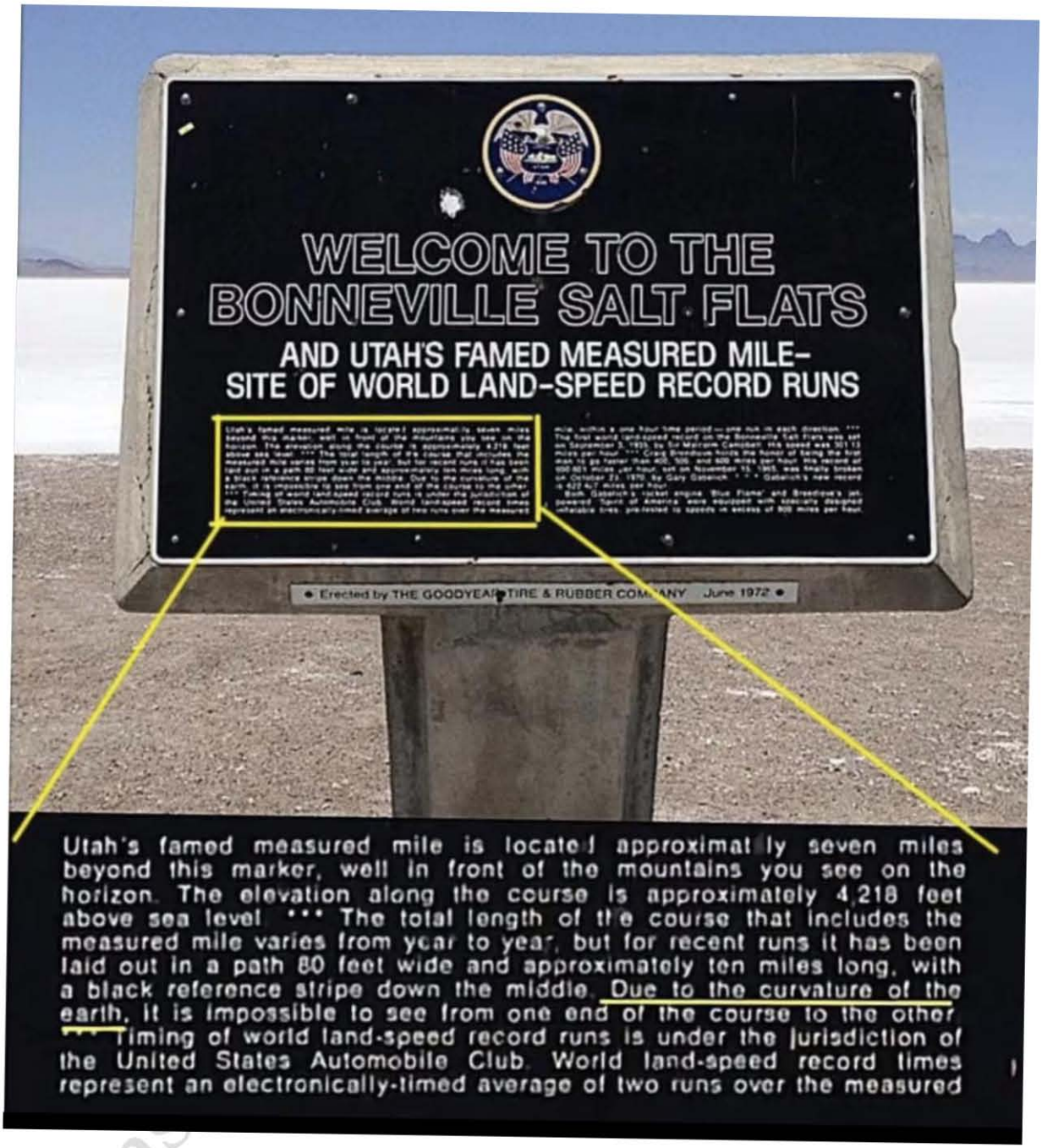


Figure 33 Topography of the Bonneville Salt Flats (source : https://fr-fr.topographic-map.com/)

Interstate 80 runs through the Bonneville Salt Flats in Utah in a nearly straight section. From the hilly terrain west of the highway, we can observe the curve of the highway following the curvature of the Earth using a long-zoom camera.

And something funny:


WELCOME TO THE
BONNEVILLE SALT FLATS
AND UTAH'S FAMED MEASURED MILE–
SITE OF WORLD LAND-SPEED RECORD RUNS
• Erected by THE GOODYEAR TIRE & RUBBER COMPANY June 1972 •
Utah's famed measured mile is located approximately seven miles beyond this marker, well in front of the mountains you see on the horizon. The elevation along the course is approximately 4,218 feet above sea level. *** The total length of the course that includes the measured mile varies from year to year, but for recent runs it has been laid out in a path 80 feet wide and approximately ten miles long, with a black reference stripe down the middle. Due to the curvature of the earth, it is impossible to see from one end of the course to the other. *** Timing of world land-speed record runs is under the jurisdiction of the United States Automobile Club. World land-speed record times represent an electronically-timed average of two runs over the measured

(#047) Burj Khalifa (Emirates)

With a total height of approximately 830 meters, Burj Khalifa remains the tallest building in the world as of 2025. It is so tall that we can watch the sunset from the base of the building, then rush to the upper floors and watch the same sunset a second time in the same day.

Figure 34 Sunset from the Burj Khalifa (author : Simon Bierwald, Nikon D800, 3 december 2014, source : Flickr)

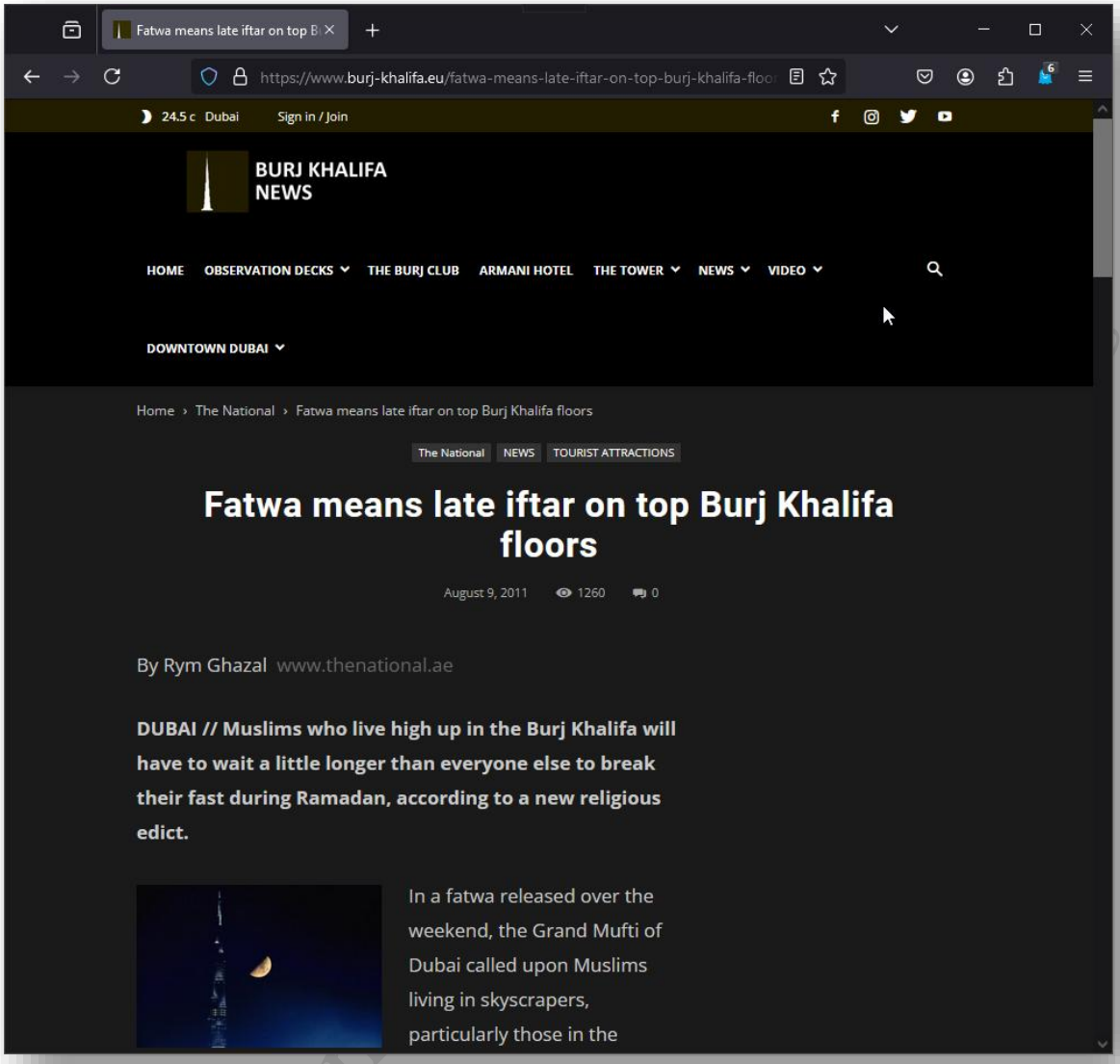
This phenomenon can only occur if the Earth is a sphere. From a higher position, we will observe the sunset later than when we are closer to the ground.

There is a difference of approximately three minutes between the first and last sunsets. For Islamic ritual reasons, the building is divided into three zones. During Ramadan, people on the highest floors must break their fast approximately two minutes later than those on the lowest floors.

This is indicated on the official Burj Khalifa website:

https://www.burj-khalifa.eu/fatwa-means-late-iftar-on-top-burj-khalifa-floors/

translation in


Fatwa means late iftar on top B
https://www.burj-khalifa.eu/fatwa-means-late-iftar-on-top-burj-khalifa-floor
24.5 c Dubai
Sign in / Join
BURJ KHALIFA NEWS
HOME
OBSERVATION DECKS
THE BURJ CLUB
ARMANI HOTEL
THE TOWER
NEWS
VIDEO
DOWNTOWN DUBAI
Home › The National › Fatwa means late iftar on top Burj Khalifa floors
The National
NEWS
TOURIST ATTRACTIONS
Fatwa means late iftar on top Burj Khalifa floors
August 9, 2011
1260
0
By Rym Ghazal www.thenational.ae
DUBAI // Muslims who live high up in the Burj Khalifa will have to wait a little longer than everyone else to break their fast during Ramadan, according to a new religious edict.
In a fatwa released over the weekend, the Grand Mufti of Dubai called upon Muslims living in skyscrapers, particularly those in the

We also have the following document related to this topic:

translation

ISSN: 2320-5407 Int. J. Adv. Res. 11(01), 1808-1812

Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/16210
DOI URL: http://dx.doi.org/10.21474/IJAR01/16210

RESEARCH ARTICLE

DIVERSITY OF TIME ZONES AT BURJ KHALIFA IN PERFORMING PRAYERS AND FASTING IN SKYSCRAPERS

Mohd Hafiz Safiai[1,2], Mohd Izhar Ariff Mohd Kashim[1,2], Md Yazid Ahmad[1], Ezad Azraai Jamsari[3], Mohamad Zulfazdlee Abul Hassan Ashari[3] and Anwar Muttaqin[3]

1. Research Centre for Sharia, Faculty of Islamic Studies, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.
2. Institute of Islam Hadhari, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.
3. Research Centre for Arabic Language and Islamic Civilization, Faculty of Islamic Studies, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

Manuscript Info

Manuscript History
Received: 30 November 2022
Final Accepted: 31 December 2022
Published: January 2023

Key words:-
Time Zones, Burj Khalifa, Prayer Times, Fasting, Skyscraper

Abstract

Determination or prayer and fasting times is an obligation for Muslims as one of the requirements for the validity of the worship rituals. The period of time for the implementation of prayer and fasting is set following the movement of the sun resulting from the Earth revolution about its axis. Earth's 24-hour revolution from west to east bringing about the apparent rising of the sun from the east and its setting in the west is an important factor in determining the time. However, a confusing situation arises for Muslims in determining the actual time for performing worship rituals when they are in high-rise buildings which are in the same position coordinates but at different heights as in towers and skyscraper buildings. This study intends to discuss the time zones with respect to determination of the worshipping time at the tallest skyscraper building in the world at this time i.e., Burj Khalifa. This study is qualitative research using an approach of document analysis. The results of the study found that height difference at Burj Khalifa gives rise to three different time zones according to the altitude. This can serve as a guide to other countries especially Malaysia which also has skyscrapers in the determination of prayer times in such buildings.

Copy Right, IJAR, 2023,. All rights reserved.

Introduction:-

One of the requirements for worship is to know the time for prayer. Every person who adheres to the religion of Islam is obliged to ascertain when the time for each obligatory prayer starts and ends. This is in line with the methodology of Islamic jurisprudence (al-Nadawi 1994): "A matter without which the obligatory will not be complete, then the matter is mandatory".If time is not a condition for whether or not a prayer is valid, then one can just fulfil the obligation of prayer at any time, before or after the period of time a prayer should be performed. Determination of the time for prayer is already explained in the *fiqh* book whereby determination of time for each prayer requires for a reference to the movement of the sun.According to al-Khin et al. (2011), prayer time can be known by the following three ways: (a) Knowing it with surety, on the basis of clear evidence such as seeing the sun rising (*shuruq*) or setting (*ghurub*); (b) *Ijtihad*, on strong evidence with indirect indication such as by measuring

Corresponding Author:- Mohd Hafiz Safiai
Address:- Research Centre for Sharia, Faculty of Islamic Studies,Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

With, on page 1811, the Earth bizarrely illustrated with a curvature (...):

ISSN: 2320-5407 Int. J. Adv. Res. 11(01), 1808-1812

for breaking of the fast time which are the same as the times for the locality which is the city of Dubai. According to the agency which reported in Anon (2019), residents in the second time zone, the start for prayers and breaking of the fast are later by 2 minutes than the first time zone, but earlier by 2 minutes for *Fajr* and the start of fasting. The difference in obligatory prayer times and the time for breaking the fast in the third zone 3 minutes later than the first zone but for the dawn prayer time it is is 3 minutes quicker than the first time zone. This situation makes residents in the third zone fast for 6 minutes longer than residents in the first zone. Figure 4.2 below shows a sketch depicting height level differences in Burj Khalifa which gives the effect on the determination of prayer time dividing it into three different zones.

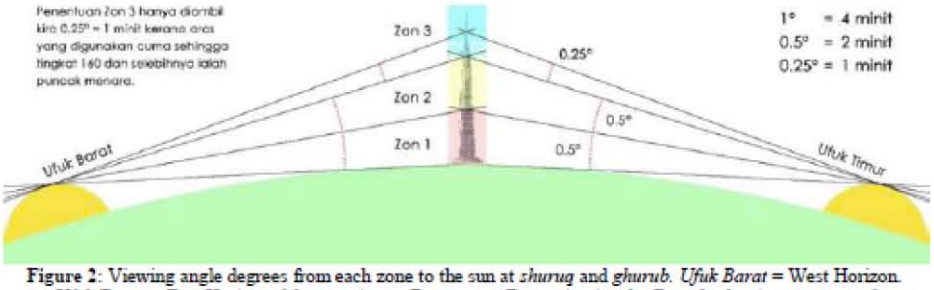

Penentuan Zon 3 hanya diambil kira 0.25° = 1 minit kerana area yang digunakan cuma sehingga tingkat 160 dan selebihnya ialah puncak menara.
Zon 3
Zon 2
Zon 1
0.25°
0.5°
0.5°
Ufuk Barat
Ufuk Timur
1° = 4 minit
0.5° = 2 minit
0.25° = 1 minit

Figure 2: Viewing angle degrees from each zone to the sun at *shurug* and *ghurub*. *Ufuk Barat* = West Horizon. *Ufuk Timur* = East Horizon. *Minit* = minute. *Zon* = zone. Determination for Zone 3 takes into account of 0.25degrees (equivalent to 1 minute) only because occupied levels are up to Level 160 and the rest is the tower pinnacle structure.

Calculation for the commencement of the dawn prayer time is considered when the sun appears in sight below the horizon at an angle of 18°. When residents in the third zone already experience *fajr sadiq*, position of the sun that can be seen by the residents in the second and first time zones are at an angle of 17.75° and 17.25° respectively. Therefore the difference in altitude degrees result in different calculation for prayer time due to the fact that every 1° of earth rotation takes 4 minutes.

As an example, if today is June 15, 2022, the dawn prayer time in the district of Dubai starts at 3:59 am, then residents in the first zone in the tower will follow the same time. Meanwhile, residents in the second zone already experience *fajr sadiq* at 3:57 am and in the third zone at 3:56 am. Similar calculation is done for *Maghrib* and *Isha'* prayers which come later by about 2-3 minutes than the local prayer time. Determination of the time for prayers in the third zone is not different by 2 minutes but by 1 minute only to the second zone because the height altitude range in the third zone is counted as half, considering that only up to level 160 of Burj Khalifa is used and the rest is the pinnacle structure of the tower (Anon 2022).

Conclusion:-

Determination of prayer time need to go through the process of observation of sunrise and sunset phenomena. After the research was done, results showed that residents in the areas of higher altitude will see sunrise earlier and sunset later. Therefore, for occupants of the tower who are on the top floors exceeding 0.5° of altitude from sea level, their time zone for prayer will be earlier at Fajr time and later at *Maghrib* and *Isha'*.This phenomenon too has an effect on the determination for the fasting time period. Though the difference is not significant and only involves a few minutes only, setting the right time is a duty and need to be known by Muslims because this matter involves the condition of validity of prayer and fasting worships. However, detailed formulae used in calculation for the degree of altitude and obligatory prayer times are not included yet. Hence, this research needs to be continued by future researchers to achieve more in-depth and extensive account for each time zone in skyscraper buildings

Acknowledgement:-

This study was financed byGeran Penyelidikan Industri (PP-2021-019), Dana Insentif Penerbitan Fakulti Pengajian Islam 2023, Universiti Kebangsaan Malaysia and Jabatan Mufti Negeri Sarawak.

Voilà voilà…

(#048) London Underground Metro (United Kingdom)

The Rossrail tunnels under London are long, so long that during their planning they were affected by something unexpected: the curvature of the Earth!

It's very important to know how the curvature of the Earth will affect your new tunnels, otherwise the tunnels won't line up when they meet. Worse still, in some of the very narrow spaces between the old tunnels, you may end up drilling directly into them. This would be embarrassing...

When the current Crossrail project was being developed in the 1990s, planners used maps based on the Ordnance Survey National Grid (NGG) reference system, but this showed to be a too rough measurement standard for the accuracy Crossrail required.

It's not that Crossrail couldn't have been dug using this system, as the older tunnels were obviously dug before modern maps, but there would have been risks of misalignment and much more time and money would have had to be spent studying the tunnels to ensure they were pointing in the right direction.

Additionally, the interfaces between Crossrail and existing infrastructure owned by Network Rail and London Underground Metro would have had to adapt to tighter modern engineering tolerances.

If they had used normal "street plans," the Crossrail tunnels could have had deviations of up to 20 cm per kilometer of tunnel, due to the curvature of the Earth. This might not be a major problem in some places, but it could have been catastrophic in central London, as the Crossrail tunnels threaded through gaps in other tube lines, sewers, and modern foundations.

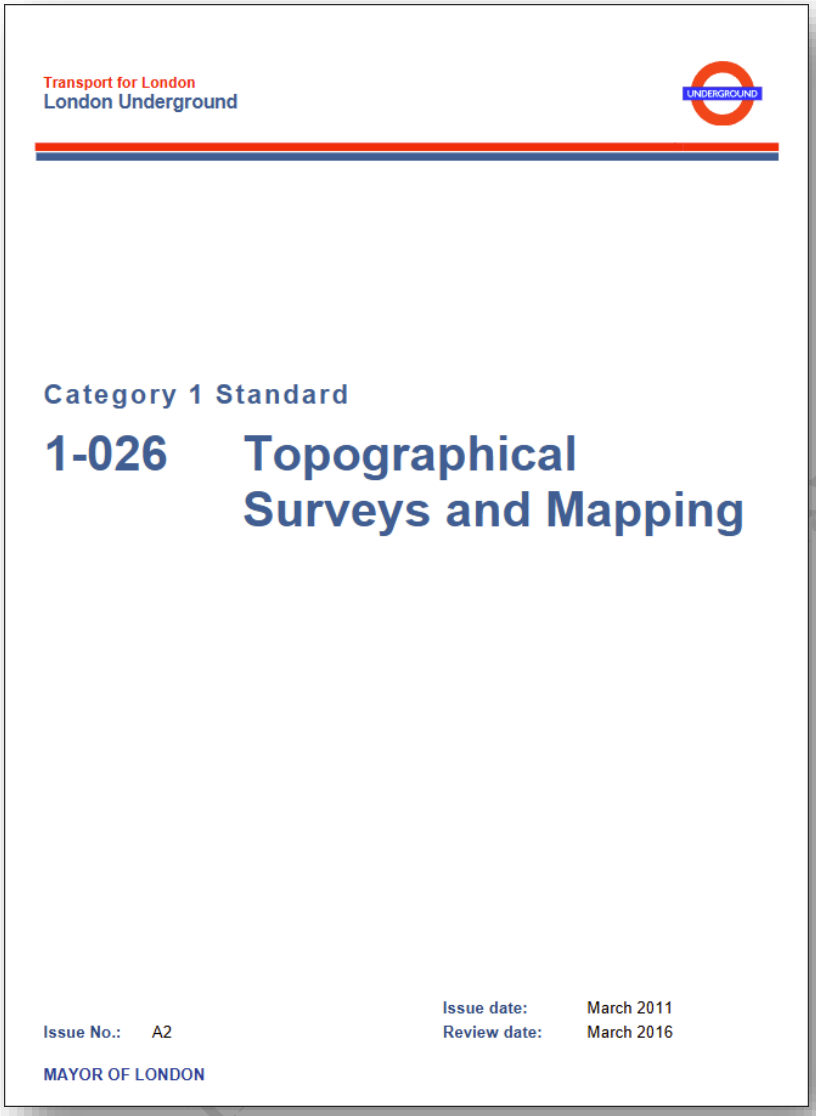
For example, Tottenham Court Road had such a narrow gap that if the curvature of the Earth had not been taken into account, the tunnel boring machine from Paddington would have been sufficiently displaced upon arrival so that the cutter head could have cut through the Northern Line tunnels.

The proof is in the London Underground public technical document available here:

https://www.engineeringsurveyor.com/software/1-026%20-%20Topographical%20Surveys%20and%20Mapping.pdf

Here is the front cover:

translation into english ongoing



Transport for London
London Underground

Category 1 Standard

1-026 Topographical Surveys and Mapping

Issue No.: A2

Issue date: March 2011
Review date: March 2016

MAYOR OF LONDON

transition ongoing

And this document has several pages referring to the problem of taking into account the curvature of the Earth, such as on page 3:

3.1 London Survey Grid and datum

3.1.1 London Survey Grid (LSG) definition

3.1.1.1 All topographical survey and mapping work shall be reported on the London Survey Grid.

Note: The London Survey Grid is a Transverse Mercator Projection with parameters chosen to minimise grid distortion caused by the Earth's curvature over the LU area. The distortion is such that for large portions of the area projection corrections can be ignored. The Grid was formerly known as the LU Grid, the LUL Grid or the Crossrail Grid

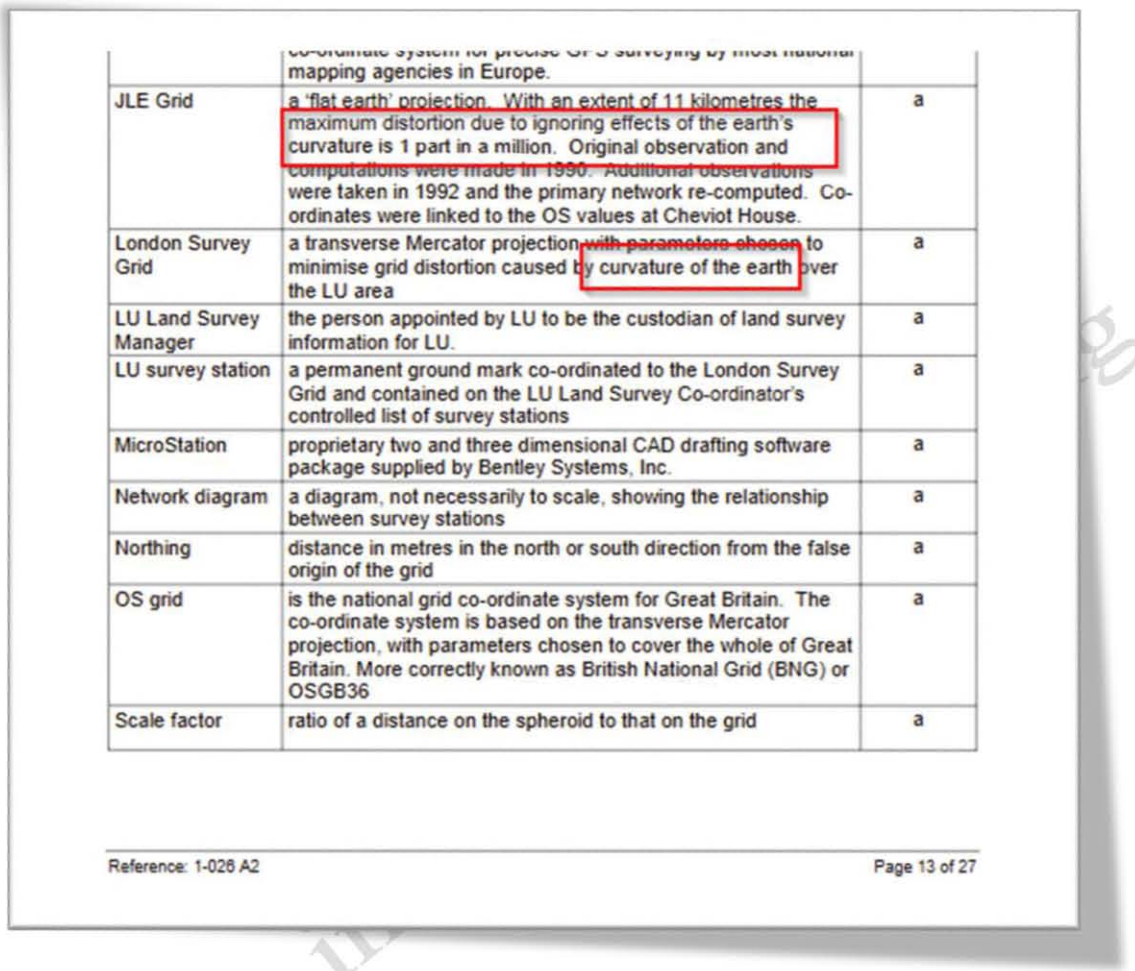
A network of primary survey stations with London Survey Grid co-ordinates has been established across London.

3.1.1.2 LSG height datum shall be used. The LSG height datum level is set at approximately 100m below OS Datum at Newlyn.

Note: The LSG height datum is an orthometric height datum chosen to provide positive values for areas of interest to LU. This datum is realised by the network of OS benchmarks that have been connected by spirit levelling to LU survey control points. . In areas that will interface with Crossrail projects the Crossrail First Order benchmarks should be used. Trials in 2009 indicated that GPS survey heights can be transformed using the Ordnance Survey Geoid Model 2002 (OSGM02), plus the 100m shift, to produce acceptable LSG Height Datum values

translation in

Or again on page 13:



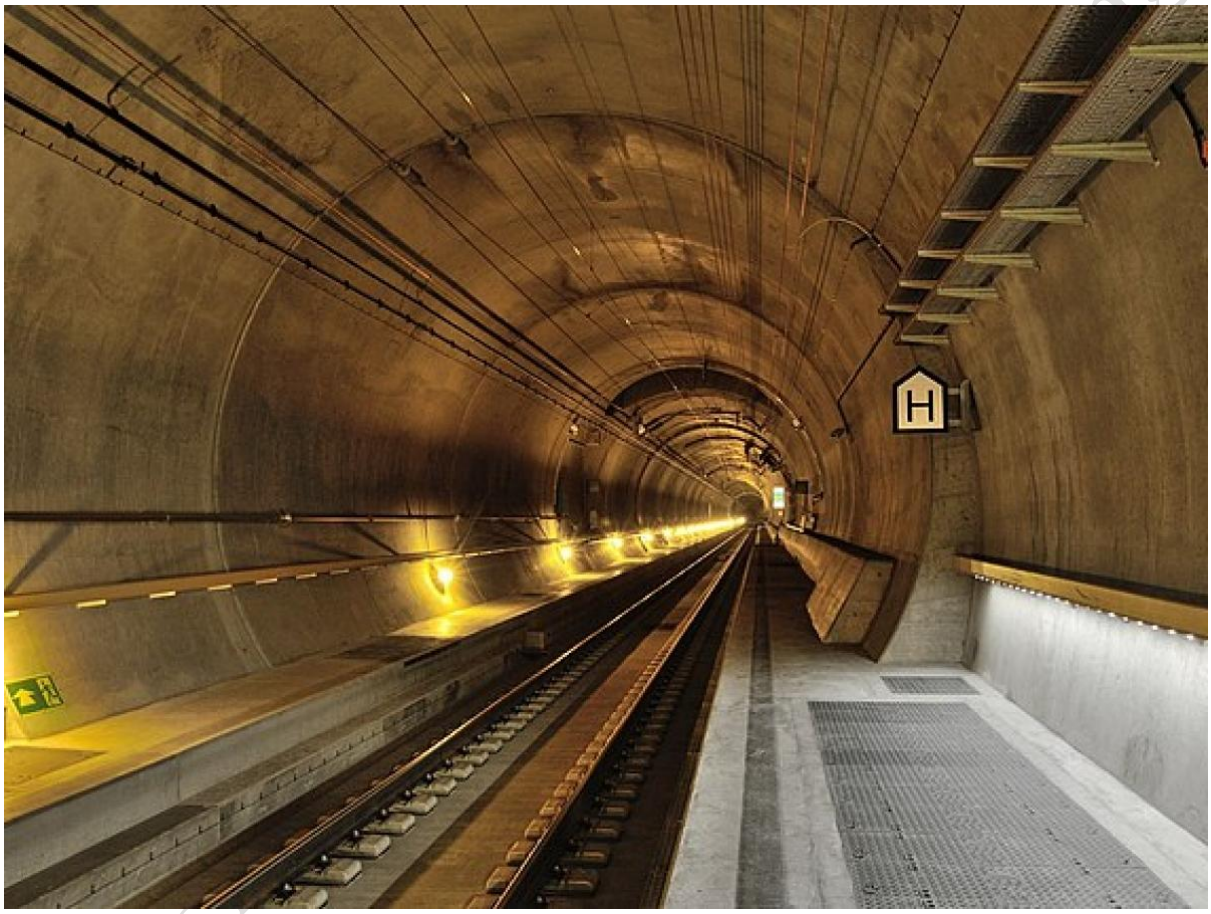
	mapping agencies in Europe.	
JLE Grid	a 'flat earth' projection. With an extent of 11 kilometres the maximum distortion due to ignoring effects of the earth's curvature is 1 part in a million. Original observation and computations were made in 1990. Additional observations were taken in 1992 and the primary network re-computed. Co-ordinates were linked to the OS values at Cheviot House.	a
London Survey Grid	a transverse Mercator projection with parameters chosen to minimise grid distortion caused by curvature of the earth over the LU area	a
LU Land Survey Manager	the person appointed by LU to be the custodian of land survey information for LU.	a
LU survey station	a permanent ground mark co-ordinated to the London Survey Grid and contained on the LU Land Survey Co-ordinator's controlled list of survey stations	a
MicroStation	proprietary two and three dimensional CAD drafting software package supplied by Bentley Systems, Inc.	a
Network diagram	a diagram, not necessarily to scale, showing the relationship between survey stations	a
Northing	distance in metres in the north or south direction from the false origin of the grid	a
OS grid	is the national grid co-ordinate system for Great Britain. The co-ordinate system is based on the transverse Mercator projection, with parameters chosen to cover the whole of Great Britain. More correctly known as British National Grid (BNG) or OSGB36	a
Scale factor	ratio of a distance on the spheroid to that on the grid	a

Reference: 1-026 A2 Page 13 of 27

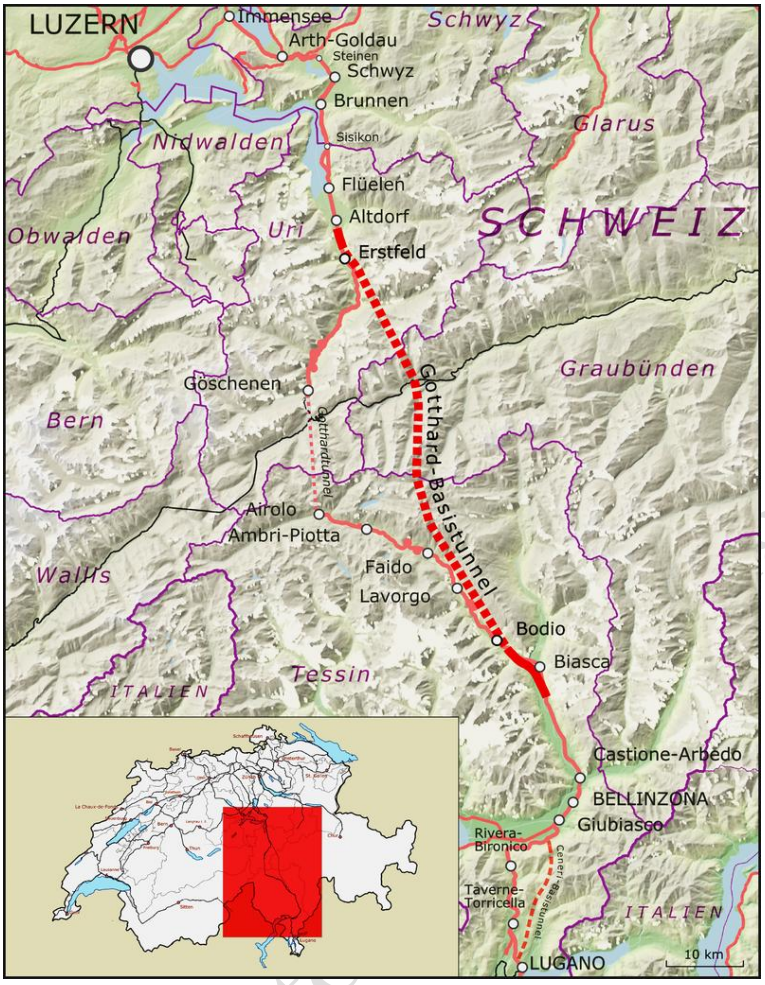
translation

(#049) Gotthard Base Tunnel (Switzerland)

The Gotthard Base Tunnel is a twin-tube railway tunnel running under the Gotthard massif in Switzerland. With 57.1 km, it is the **longest tunnel in the world** as of 2020. It connects Erstfeld in the canton of Uri to Bodio in the canton of Ticino. It is also the deepest tunnel in the world, with its rock cover reaching a height of 2,450 meters. Construction began in 1996, boring was completed in 2011, and commercial operation began on December 11, 2016. It is primarily intended for high-speed rail traffic. For passengers, the train journey time between Zurich and Milan is reduced to 2 hours 40 minutes. It is a base tunnel, meaning it is low-altitude, thus avoiding the need for trains to ascend to access it.



Here is its geographical location:



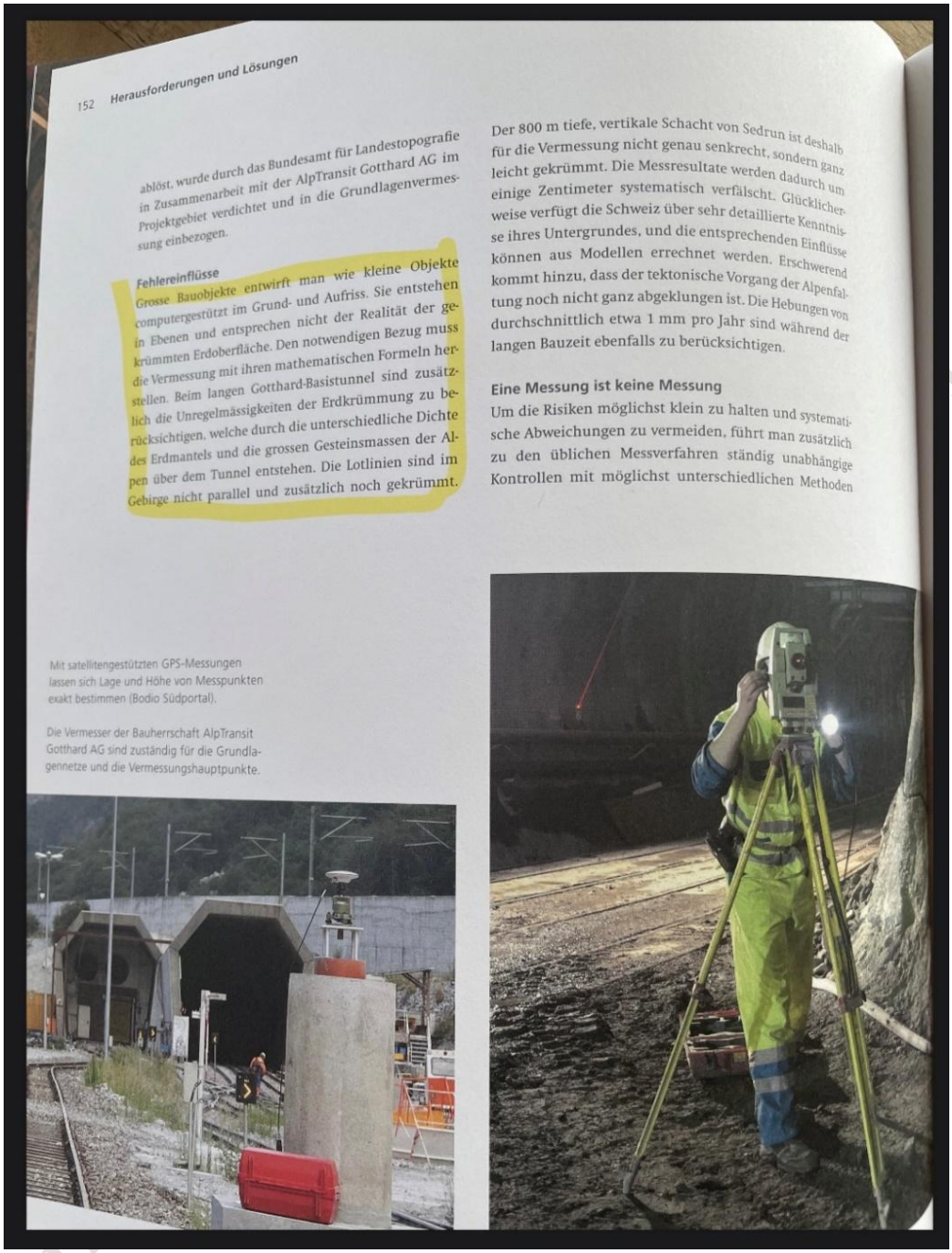
As stated in the reference book documenting the Base Tunnel construction project available for purchase here:

https://www.exlibris.ch/de/buecher-buch/deutschsprachige-buecher/das-jahrhundertbauwerk-entsteht/id/9783727212116

translation in progress

The curvature of the Earth had to be taken into account so that the trains could run correctly on the rails :

translation in



152 Herausforderungen und Lösungen

ablöst, wurde durch das Bundesamt für Landestopografie in Zusammenarbeit mit der AlpTransit Gotthard AG im Projektgebiet verdichtet und in die Grundlagenvermessung einbezogen.

Fehlereinflüsse

Grosse Bauobjekte entwirft man wie kleine Objekte computergestützt im Grund- und Aufriss. Sie entstehen in Ebenen und entsprechen nicht der Realität der gekrümmten Erdoberfläche. Den notwendigen Bezug muss die Vermessung mit ihren mathematischen Formeln herstellen. Beim langen Gotthard-Basistunnel sind zusätzlich die Unregelmässigkeiten der Erdkrümmung zu berücksichtigen, welche durch die unterschiedliche Dichte des Erdmantels und die grossen Gesteinsmassen der Alpen über dem Tunnel entstehen. Die Lotlinien sind im Gebirge nicht parallel und zusätzlich noch gekrümmt.

Der 800 m tiefe, vertikale Schacht von Sedrun ist deshalb für die Vermessung nicht genau senkrecht, sondern ganz leicht gekrümmt. Die Messresultate werden dadurch um einige Zentimeter systematisch verfälscht. Glücklicherweise verfügt die Schweiz über sehr detaillierte Kenntnisse ihres Untergrundes, und die entsprechenden Einflüsse können aus Modellen errechnet werden. Erschwerend kommt hinzu, dass der tektonische Vorgang der Alpenfaltung noch nicht ganz abgeklungen ist. Die Hebungen von durchschnittlich etwa 1 mm pro Jahr sind während der langen Bauzeit ebenfalls zu berücksichtigen.

Eine Messung ist keine Messung

Um die Risiken möglichst klein zu halten und systematische Abweichungen zu vermeiden, führt man zusätzlich zu den üblichen Messverfahren ständig unabhängige Kontrollen mit möglichst unterschiedlichen Methoden

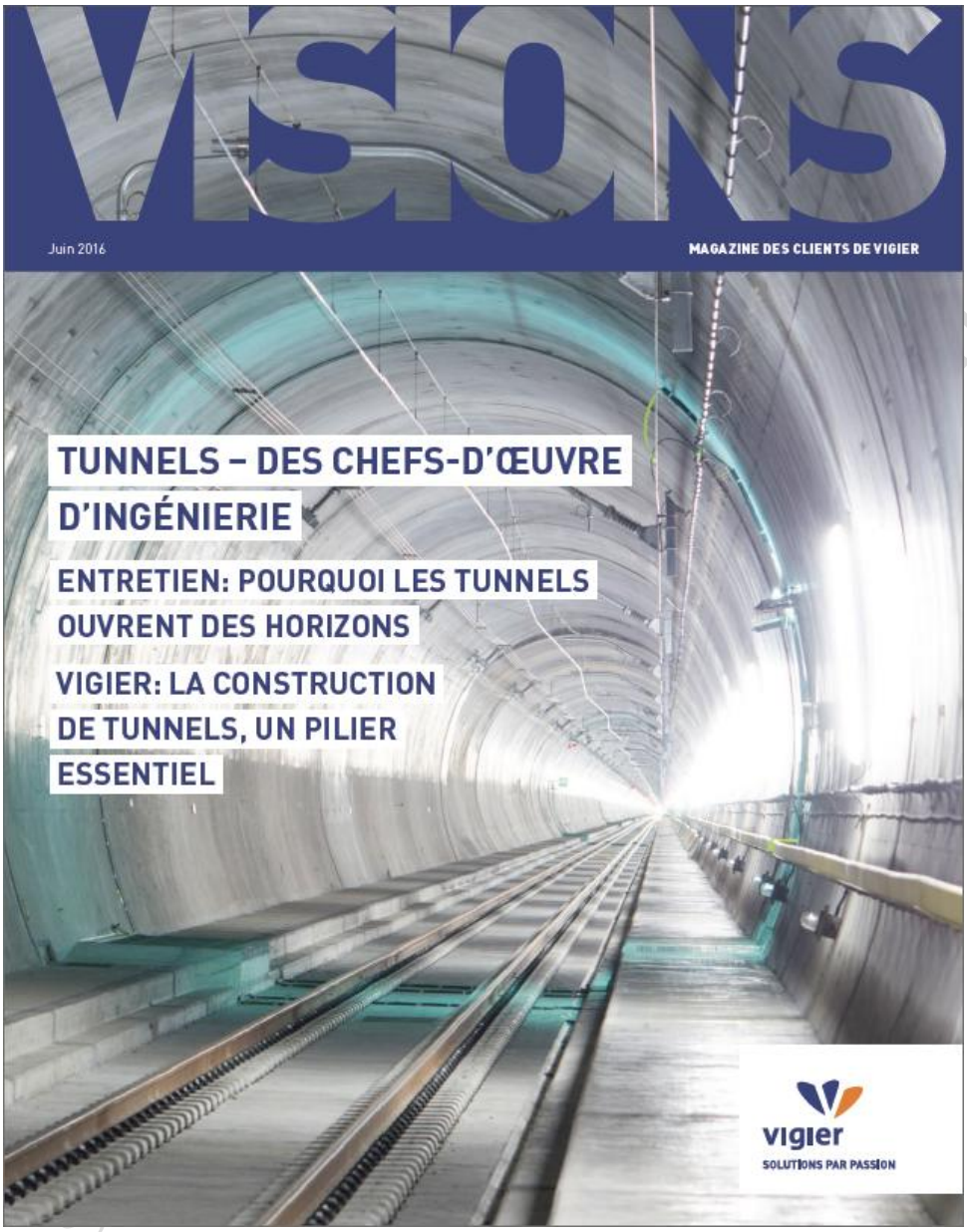
Mit satellitengestützten GPS-Messungen lassen sich Lage und Höhe von Messpunkten exakt bestimmen (Bodio Südportal).

Die Vermesser der Bauherrschaft AlpTransit Gotthard AG sind zuständig für die Grundlagennetze und die Vermessungshauptpunkte.

Here is the translation of the interesting part from German to English:

"Like small objects, large construction projects are designed using computer-aided floor plans and elevations. They appear on blueprints and do not correspond to the reality of the Earth's curved surface. The necessary reference must be established by surveys with their mathematical formulas. In the case of the long Gotthard Base Tunnel, the irregularities in the Earth's curvature, which result from the different densities of the Earth's mantle and the large rock masses of the Alps above the tunnel, must also be taken into account. Plumb lines in the mountains are not parallel and are also curved."

Furthermore, the Swiss company Vigier, which specializes in tunneling, among other things, confirms in its *Visions* magazine of June 2016:


VISIONS
Juin 2016
MAGAZINE DES CLIENTS DE VIGIER
TUNNELS – DES CHEFS-D'ŒUVRE D'INGÉNIERIE
ENTRETIEN: POURQUOI LES TUNNELS OUVRENT DES HORIZONS
VIGIER: LA CONSTRUCTION DE TUNNELS, UN PILIER ESSENTIEL
vigier
SOLUTIONS PAR PASSION

Available here:

https://www.vigier.ch/sites/default/files/2020-04/Ausgabe%20VISIONS%202016_f.pdf

Confirms on page 9 that the curvature of the Earth is a parameter to be taken into account by tunnel builders:

Percée principale du tunnel de base du Saint-Gothard à Sedrun: après de nombreuses années de travail, c'est toujours un véritable événement pour toutes les personnes impliquées.

ne suit pas totalement le tracé prévu sur les plans d'origine, car il a fallu contourner une partie de la route initiale après que quelque 7000 mètres cubes de sable, de gravier et de boue provenant du dôme du Doldenhorn se sont déversés dans les galeries sur 1,5 kilomètre.

Les constructeurs de tunnels sont donc aussi des spécialistes des travaux complexes. Les longs tunnels sont creusés simultanément des deux côtés, ce qui suppose des techniques de mesure ultra-précises. Ces tunnels ne sont plus construits en ligne droite, mais suivent un tracé en courbes tenant compte du centre de la Terre et de la courbure de la surface terrestre. La variante minière est une construction fermée. Par ailleurs, on réalise des tunnels à ciel ouvert qui ne deviennent de véritables tunnels qu'une fois les tranchées couvertes en fin de travaux.

Les engins de chantier fonctionnent avec des moteurs électriques afin de garantir aux ouvriers un air sain et respirable. Les systèmes de ventilation jouent un rôle crucial. Dans la mesure du possible, les galeries sont libérées des gaz d'échappement et alimentées en oxygène par ventilation naturelle. De grands ventilateurs contribuent également à la circulation de l'air: ils aspirent l'air vicié par des cheminées d'extraction, ce qui crée une dépression provoquant l'aspiration d'air frais en tête de tunnel. De nombreuses mesures de sécurité sont requises pour l'exploitation des tunnels, que ce soient des systèmes de drainage des liquides inflammables, des détecteurs d'incendie, des galeries de secours ou des éclairages de sécurité pour n'en citer que quelques-uns.

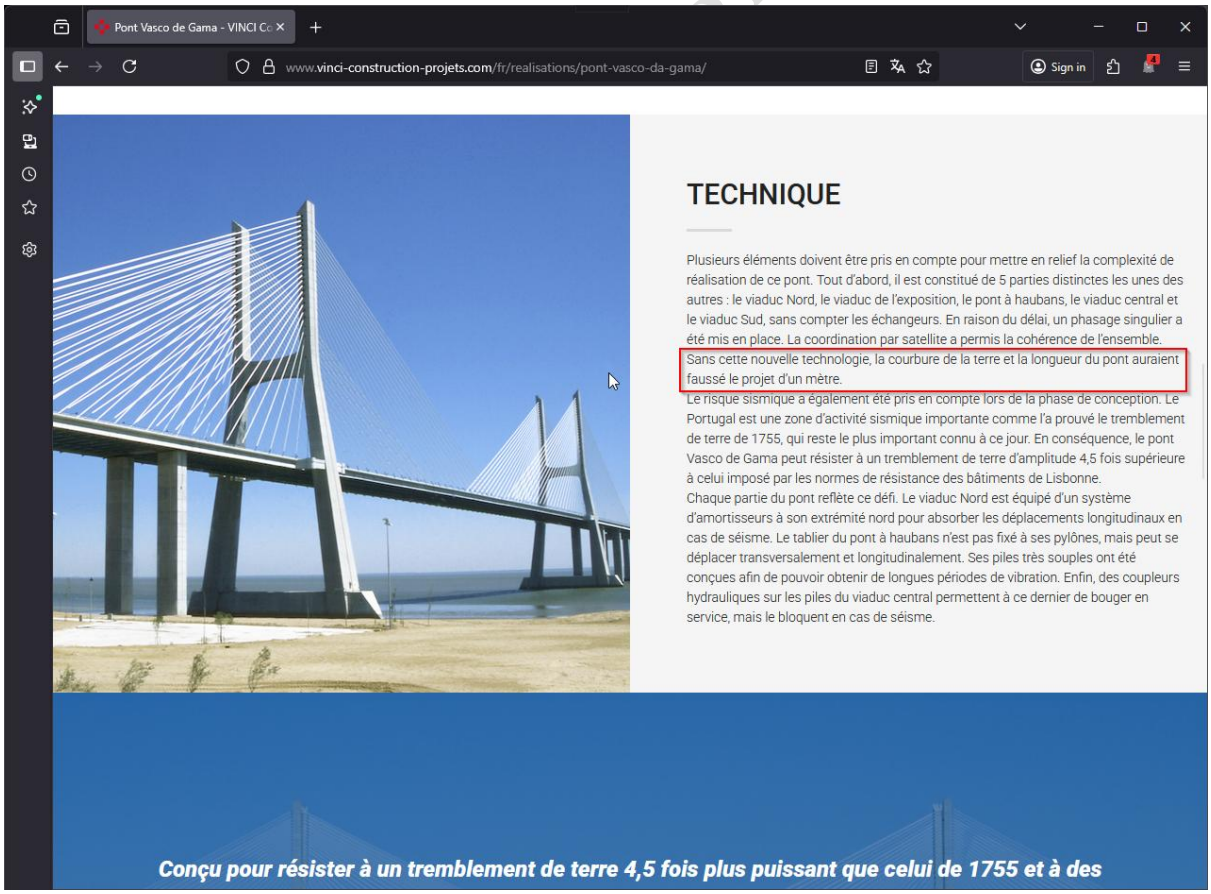
Where it is written in the red box: "…taking into account the center of Earth and the curvature of Earth's surface,"

(#050) Vasco de Gama Bridge

The Vasco da Gama Bridge, inaugurated in 1998 for the Lisbon World Expo, is a feat of modern engineering that spans more than 17 kilometers over the Tagus estuary. Designed to connect Lisbon's urbanized north bank to its more rural south bank, it relieved traffic congestion on the 25th of April Bridge and stimulated regional development. This steel-concrete viaduct, composed of five separate sections, was designed to withstand earthquakes of magnitude equivalent to that of 1755 (8.7 on the Richter scale) and cyclonic winds reaching 250 km/h.

The project was led by Vinci Construction Grands Projets, in partnership with Mota-Engil, mobilizing more than 3,300 people on the site. One of the major constraints encountered was the exceptional length of the structure, which required rigorous consideration of the Earth's curvature in the leveling and alignment calculations. Over such a distance, the curvature of the Earth induces a difference of several meters between the ends of the bridge if we refer to a theoretical straight line. The engineers therefore integrated this geodetic reality into the plans in order to guarantee the stability, precision and safety of the infrastructure along its entire length. As the project description on the official website of the company responsible for the project attests:

https://www.vinci-construction-projets.com/fr/realisations/pont-vasco-da-gama/


Pont Vasco de Gama - VINCI Co
www.vinci-construction-projets.com/fr/realisations/pont-vasco-da-gama/
Sign in
TECHNIQUE
Plusieurs éléments doivent être pris en compte pour mettre en relief la complexité de réalisation de ce pont. Tout d'abord, il est constitué de 5 parties distinctes les unes des autres : le viaduc Nord, le viaduc de l'exposition, le pont à haubans, le viaduc central et le viaduc Sud, sans compter les échangeurs. En raison du délai, un phasage singulier a été mis en place. La coordination par satellite a permis la cohérence de l'ensemble.
Sans cette nouvelle technologie, la courbure de la terre et la longueur du pont auraient faussé le projet d'un mètre.
Le risque sismique a également été pris en compte lors de la phase de conception. Le Portugal est une zone d'activité sismique importante comme l'a prouvé le tremblement de terre de 1755, qui reste le plus important connu à ce jour. En conséquence, le pont Vasco de Gama peut résister à un tremblement de terre d'amplitude 4,5 fois supérieure à celui imposé par les normes de résistance des bâtiments de Lisbonne.
Chaque partie du pont reflète ce défi. Le viaduc Nord est équipé d'un système d'amortisseurs à son extrémité nord pour absorber les déplacements longitudinaux en cas de séisme. Le tablier du pont à haubans n'est pas fixé à ses pylônes, mais peut se déplacer transversalement et longitudinalement. Ses piles très souples ont été conçues afin de pouvoir obtenir de longues périodes de vibration. Enfin, des coupleurs hydrauliques sur les piles du viaduc central permettent à ce dernier de bouger en service, mais le bloquent en cas de séisme.
Conçu pour résister à un tremblement de terre 4,5 fois plus puissant que celui de 1755 et à des

Or translated into English: “Without this new technology, the curvature of the Earth and the length of the bridge would have distorted the project by a meter.”

Means of transport and buildings disappearing below the horizon

The most famous example of evidence of the oblate Earth is the means of transport (ships, planes) disappearing below the horizon.

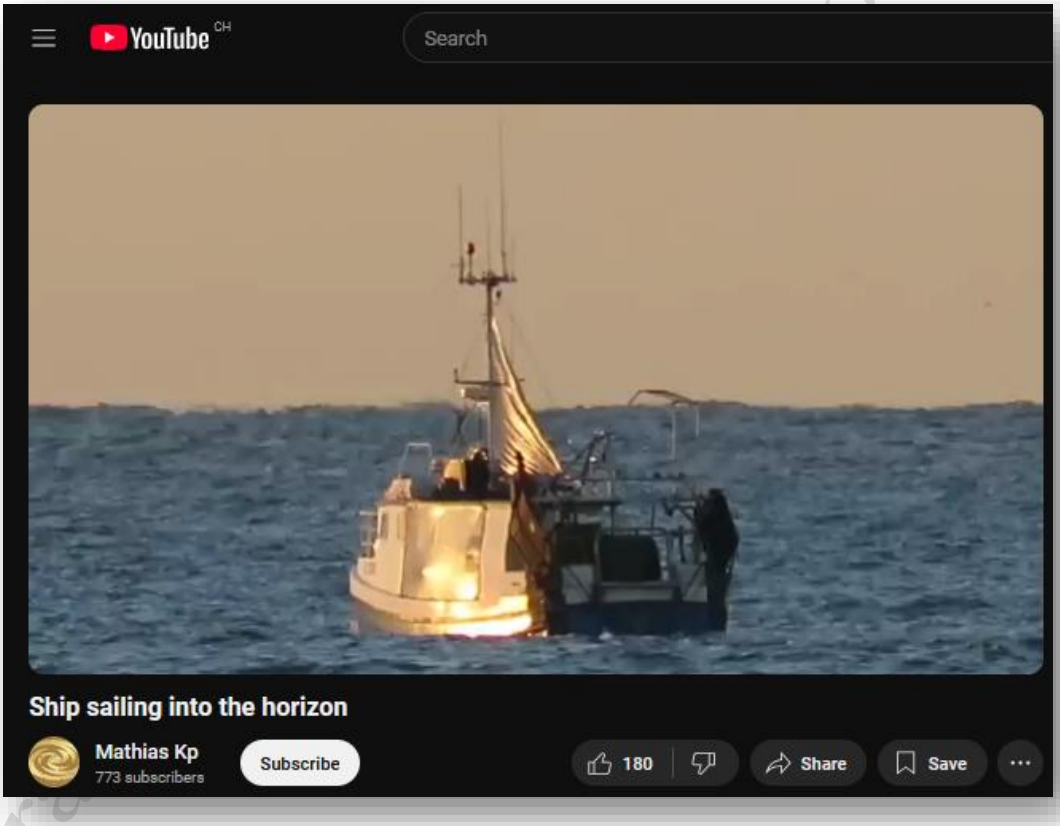
There is a whole collection of boats and structures disappearing below the horizon available on the following TikTok account:

https://www.tiktok.com/@christian_avalos_antitp

(#051-055) Boats disappearing below the horizon

Below is a mosaic of photos of a fishing boat disappearing below the horizon, taken from the video available here:

https://www.youtube.com/watch?v=8Akip2Ev_N8



Here is a mosaic from it:

Figure 35 Source : "Mathias Kp", preview image of "Ship sailing into the horizon", YouTube, February 2016

To help the reader understand what is happening, here is a figure that illustrates the principle:

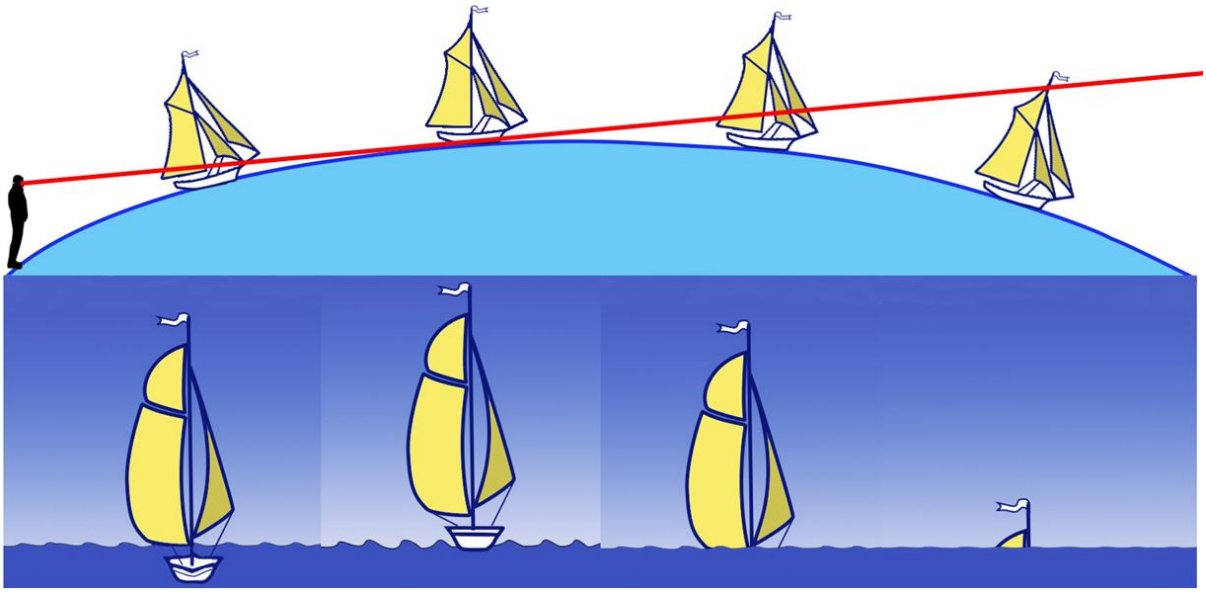


Figure 36 Illustration of what happens when a boat disappears below the horizon (source: http://canigou.allauch.free.fr)

Clearly, a boat would not disappear here on a flat Earth because that would violate the laws of linear perspective and is incompatible with homographic equations.

And you don't need to go to the ocean to see the curvature. A trip to Lake Constance in Germany allows you to see the curvature as well!

The photo below shows the effect of the Earth's curvature on Lake Constance. The location was the car deck of the Lake Constance ferry "Fritz Arnold", at the entrance to the Meersburg ferry port. In the background, you can see Bodman-Ludwigshafen, 21 kilometers away. The

low-lying areas near the banks are hidden behind the Earth's curvature. The hull is invisible from more distant sailboats. Mirages can be seen on the water near the horizon. The photo was taken with a telephoto lens with a focal length of 300 mm on a camera with a crop factor of 1.5. Its size is not reduced, but rather cropped. The original image size was 3,872 x 2,592 pixels. A polarizing filter was used, which reduces the visibility of the haze but slightly affects the resolution.

Auch am Bodensee ist die Erdkrümmung vorhanden!
Segel ohne sichtbare Bootsrümpfe
CASA REHA Seniorenheim Ludwigshafen
21 km entfernt, 3 Stockwerke vom Wasser verdeckt
Fotostandort: Fahrzeugdeck der Autofähre "Fritz Arnold" bei der Einfahrt in den Fährhafen Meersburg

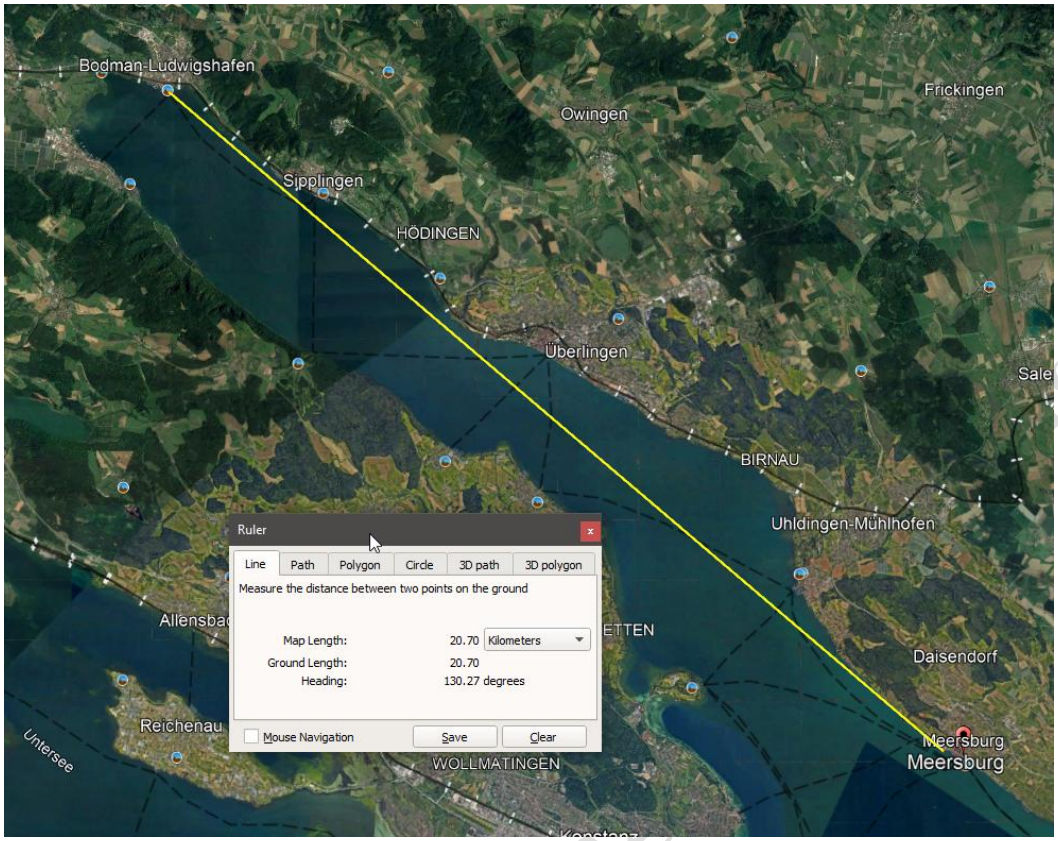
Figure 37 Courbure de la Terre sur le lac de Constance le 15 août 2009 (source : Wikipédia)

Here is the link to the original high-resolution image:

https://upload.wikimedia.org/wikipedia/commons/8/89/Erdkr%C3%BCmmung_Bodensee_IMGP3042.jpg

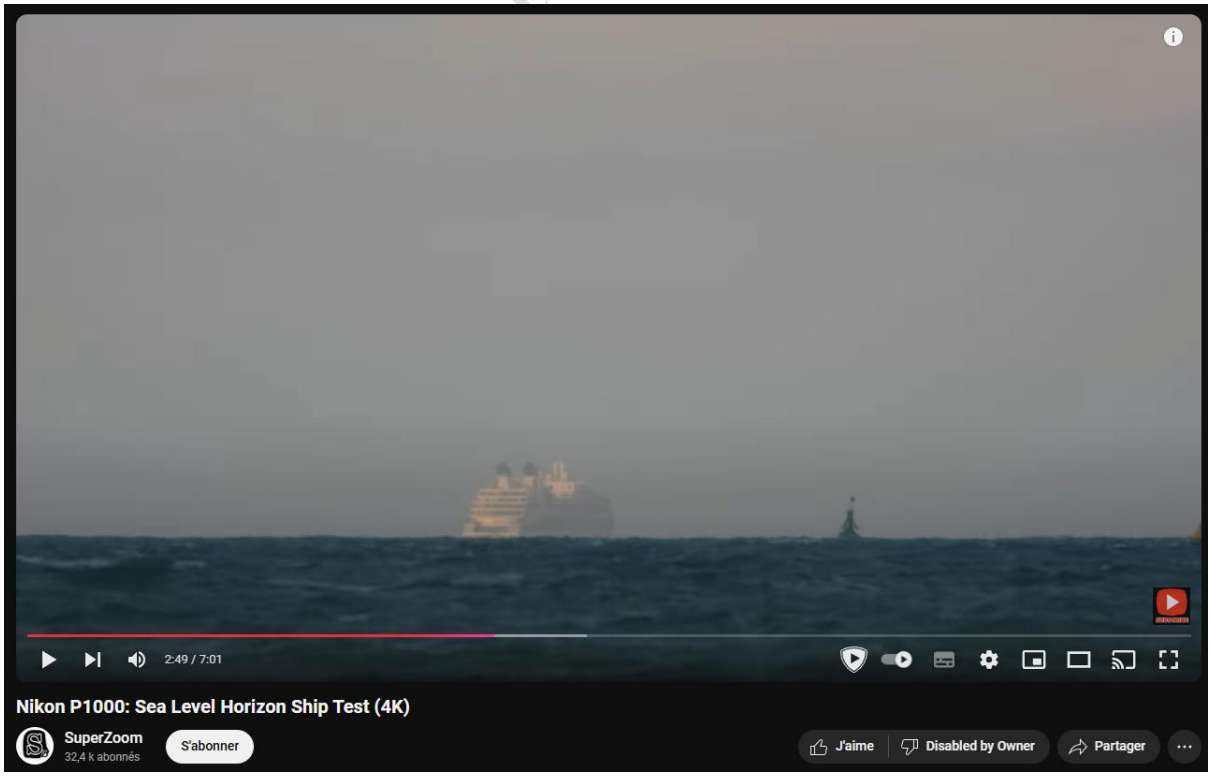
And the context:

translation into engl



The reader will also find here:

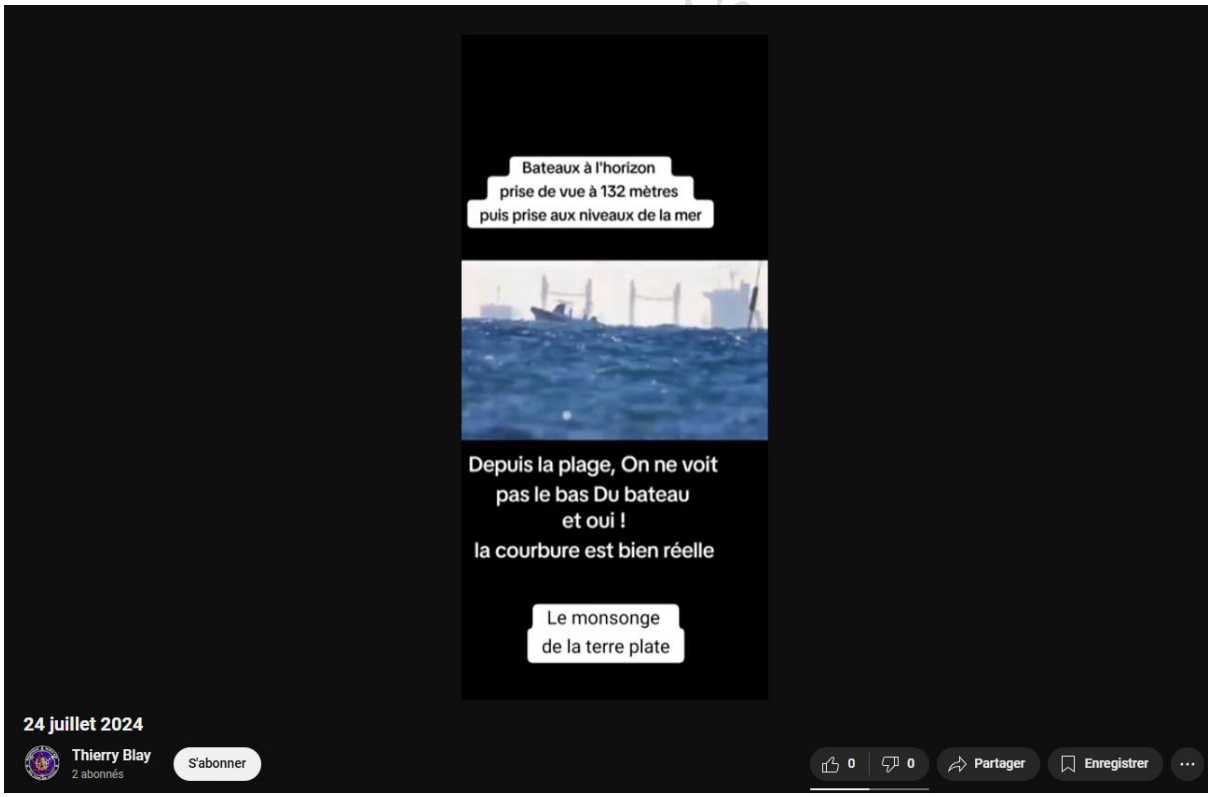
https://www.youtube.com/watch?v=Mf905v8TKNE



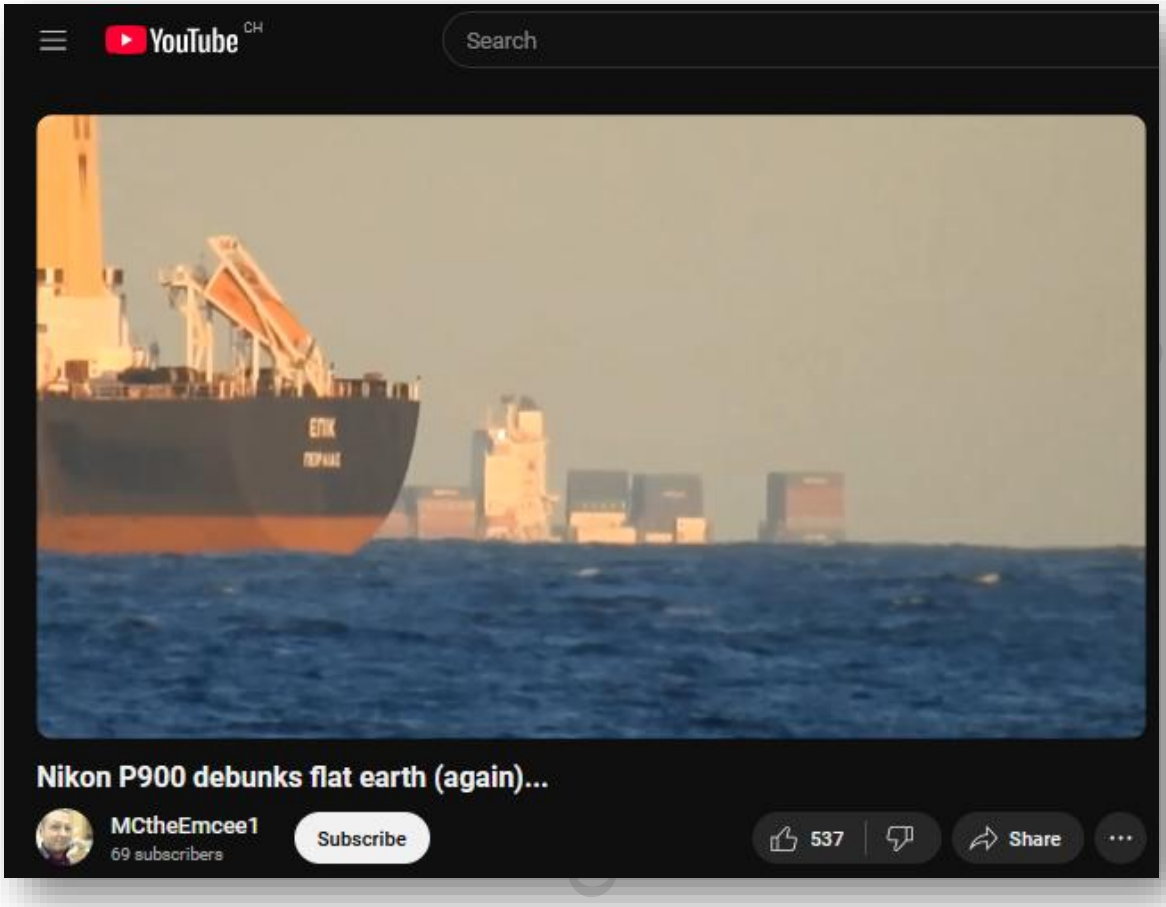
the video of a boat disappearing below the horizon captured with a Nikon P1000:

And the same here too with the same type of device:

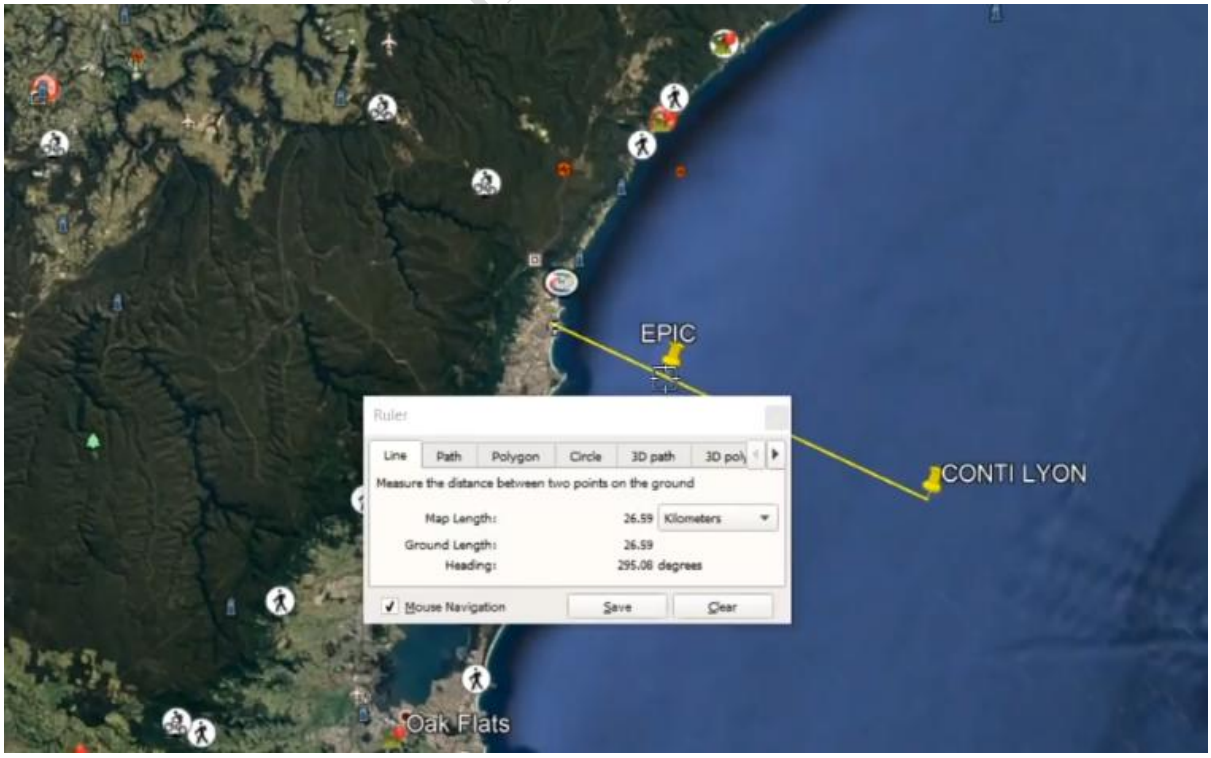
https://www.youtube.com/watch?v=OAUZwnKYbds



Or here with a Nikon P900 from Wollongong (Australia) where the first boat is the EPIC about 8 kilometers away and the second boat is the Conti Lyon and is about 26 kilometers away:



The context is available here:



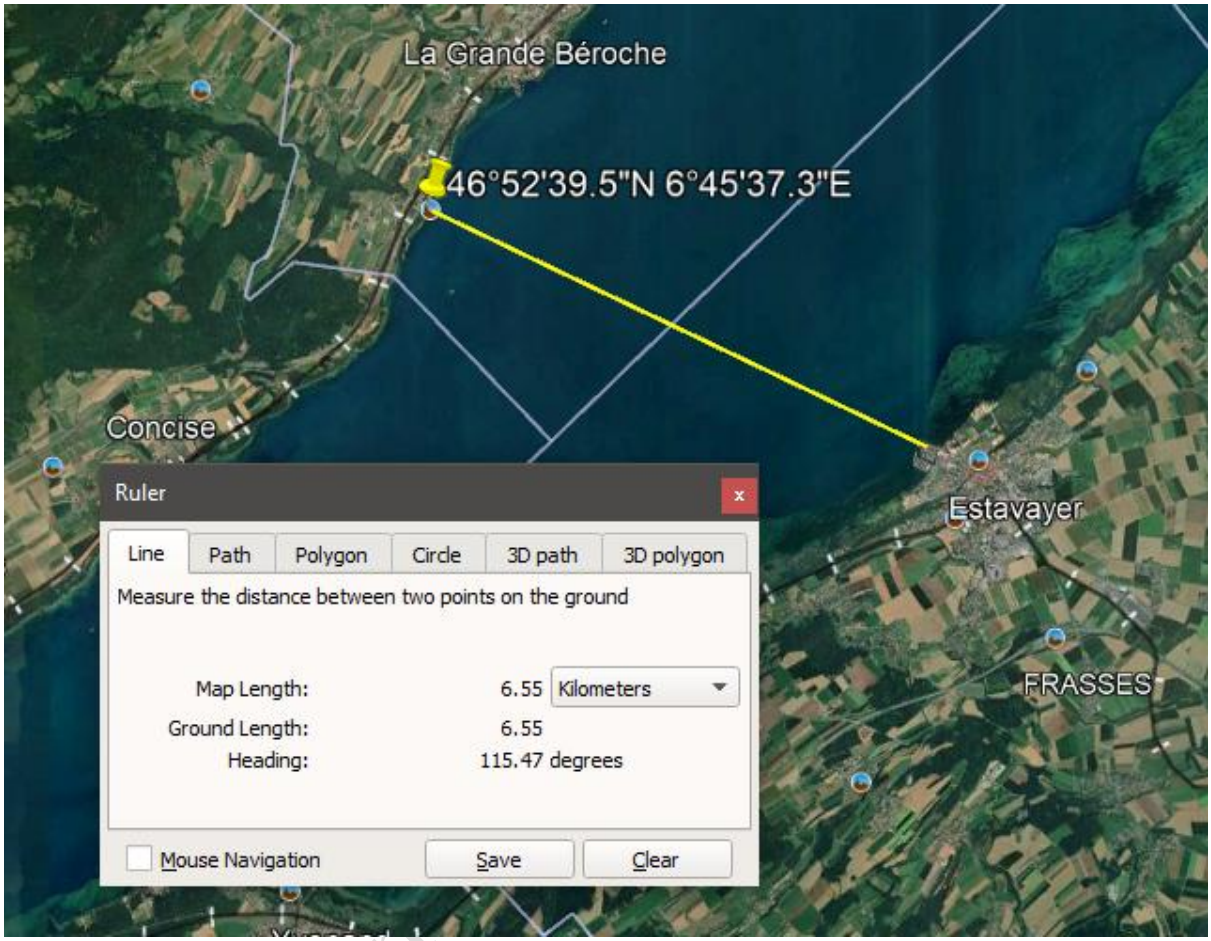
We also have here a combo destroying the lie of the flat Earth with a photo a boat disappearing under the curvature and at the same time the Sun doing the same in the background and which in addition illuminates the clouds from below (magnificent empirical observation!):

Figure 38 Sun and MSC container ship disappearing below the horizon (photo: Charles Messier, April 19, 2025, from Wimereux, Pas de Calais, facing the English Channel (France), 1600 mm focal length, Sony A7s (in APC-C) + 1060 mm telescope)

translation into

(#056-061) Buildings disappearing below the horizon

Or also in Vaumarcus (Vaumarcus beach) in the canton of Neuchâtel in Switzerland (46°52’39.5"N 6°45’37.3") towards Estavayer le Lac:



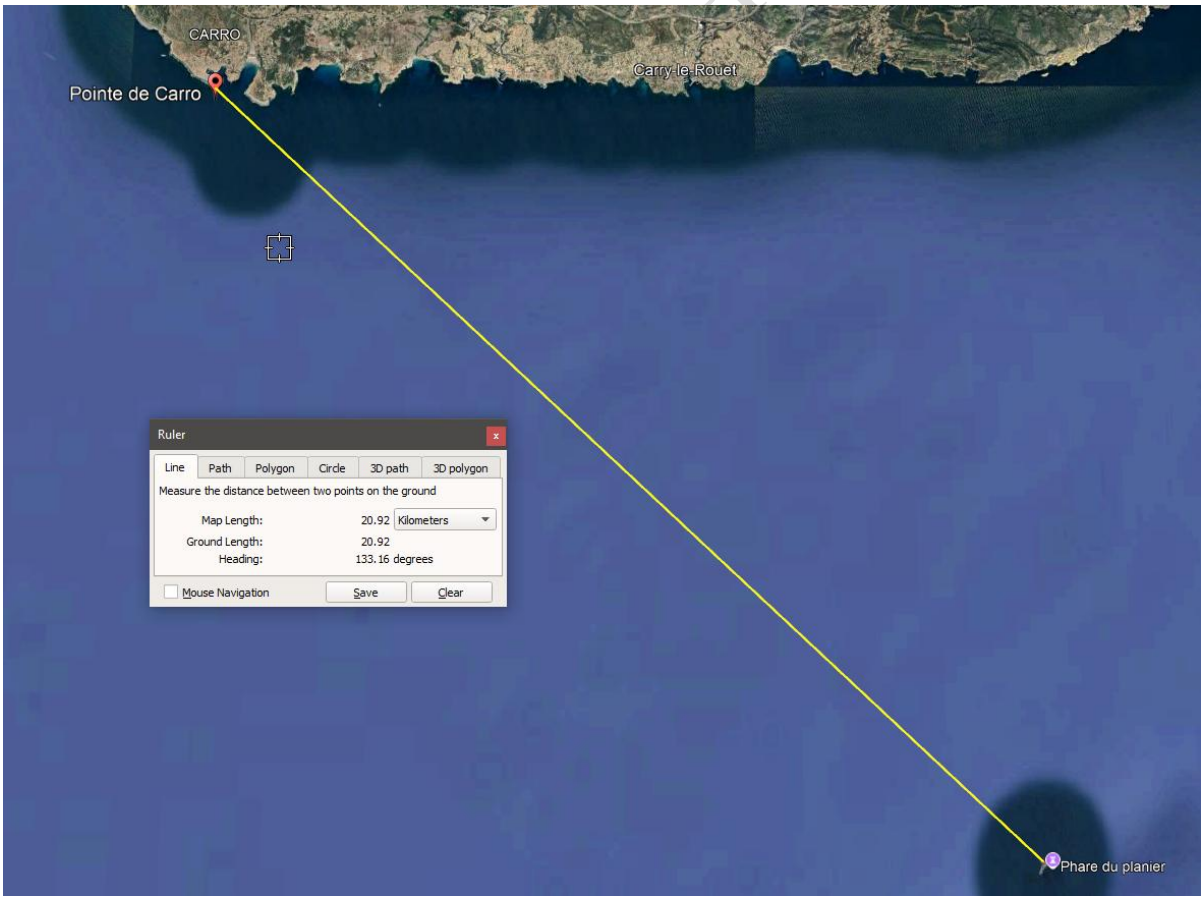
Here are four photos side by side with a point of view at different heights (taken with an iPhone 15 Pro Max with 5x optical zoom):

translation

We can clearly see that the "Restaurant des Lacustres" disappears below the horizon in accordance with the mathematical laws of a spherical Earth. The empirical, reproducible and calculable observation is therefore incompatible with a flat Earth!

Otherwise, we have the case of a lighthouse in France photographed by Olivier Joseph[5] (Canon EOS 70D, 70-33 mm lens). Indeed, between the Pointe du Carro in Martingue in France and the Planier lighthouse:

we have for context :

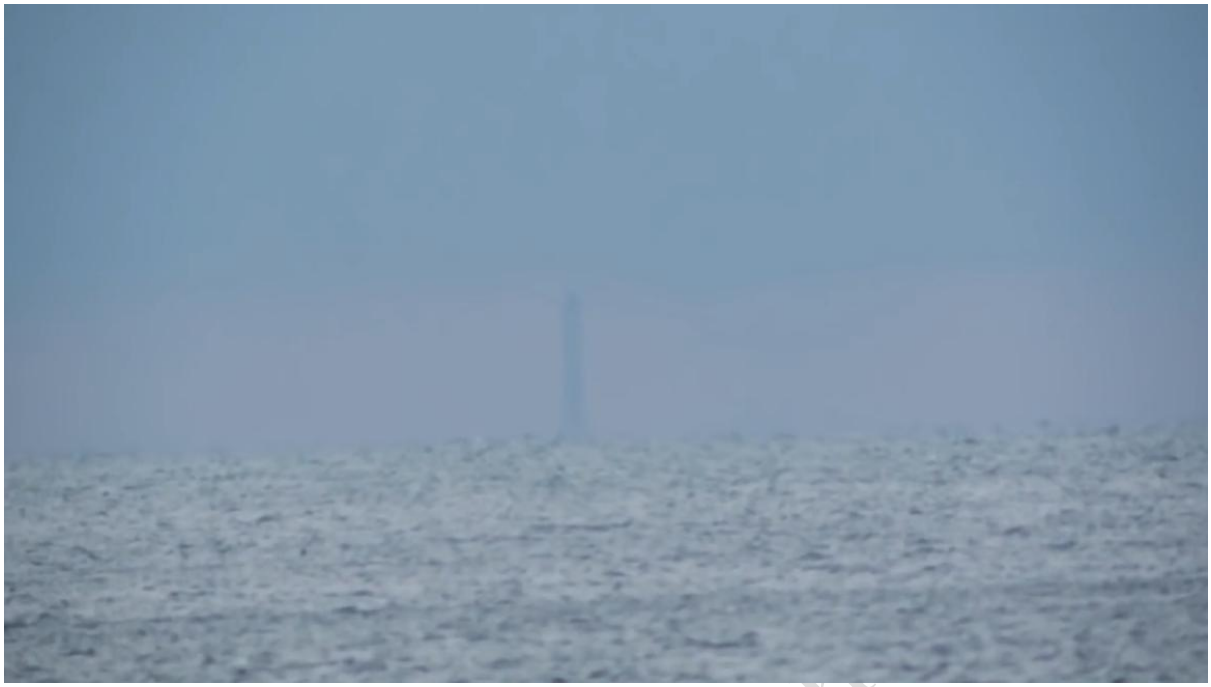


[5]See https://www.youtube.com/watch?v=zI_bi4Q8GUA

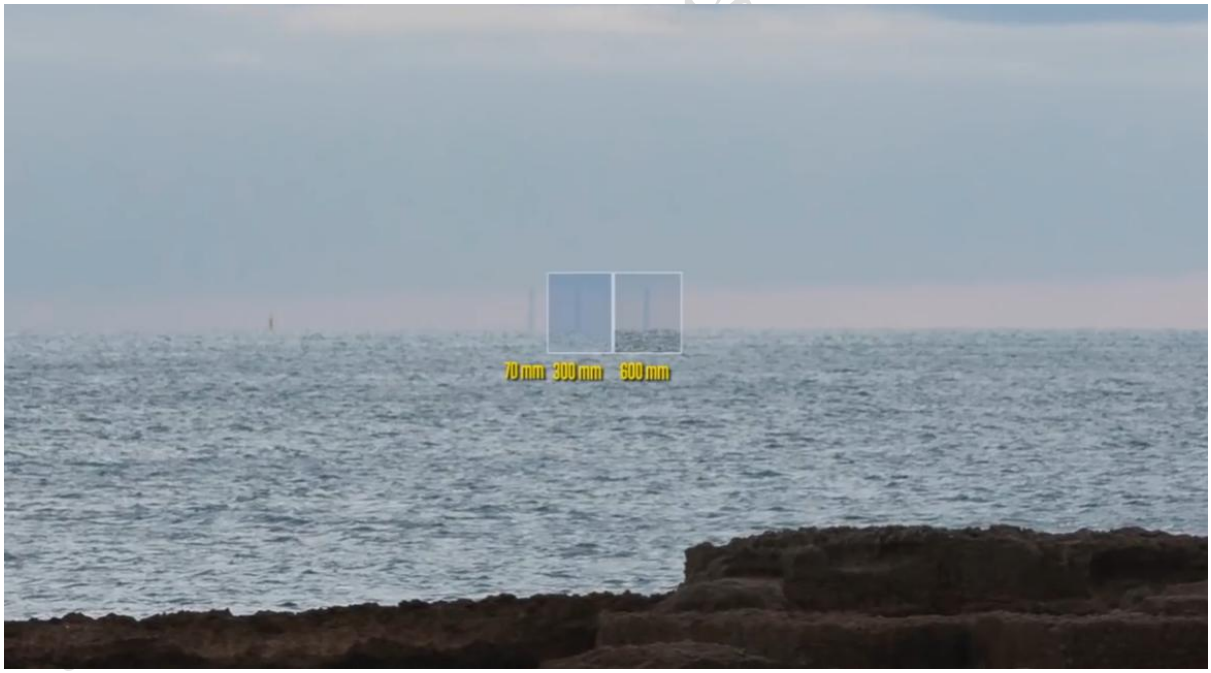
With a 70 mm lens we get:

With a 300 mm lens:

And at the focus of a 600 mm astronomical telescope:



By putting the last two photos at the same angular dimensions as the first and putting them side by side, we get:



And therefore, contrary to the lies of the flat-earthers with the Nikon P900 or P1000, zooming does not make objects reappear. Moreover, you will not see any video form flat-Earth supporters make with the P900 or P1000 that makes boats (or the Sun) reappear once it is below horizon...

Buildings near the lighthouse about 15 meters away are not visible according to curvature calculations with different refractive indices:

Earth's Curve Horizon, Bulge, Drop, and Hidden Calculator

Distance in Kilometers: 21

Viewer height in Meters: 1.8

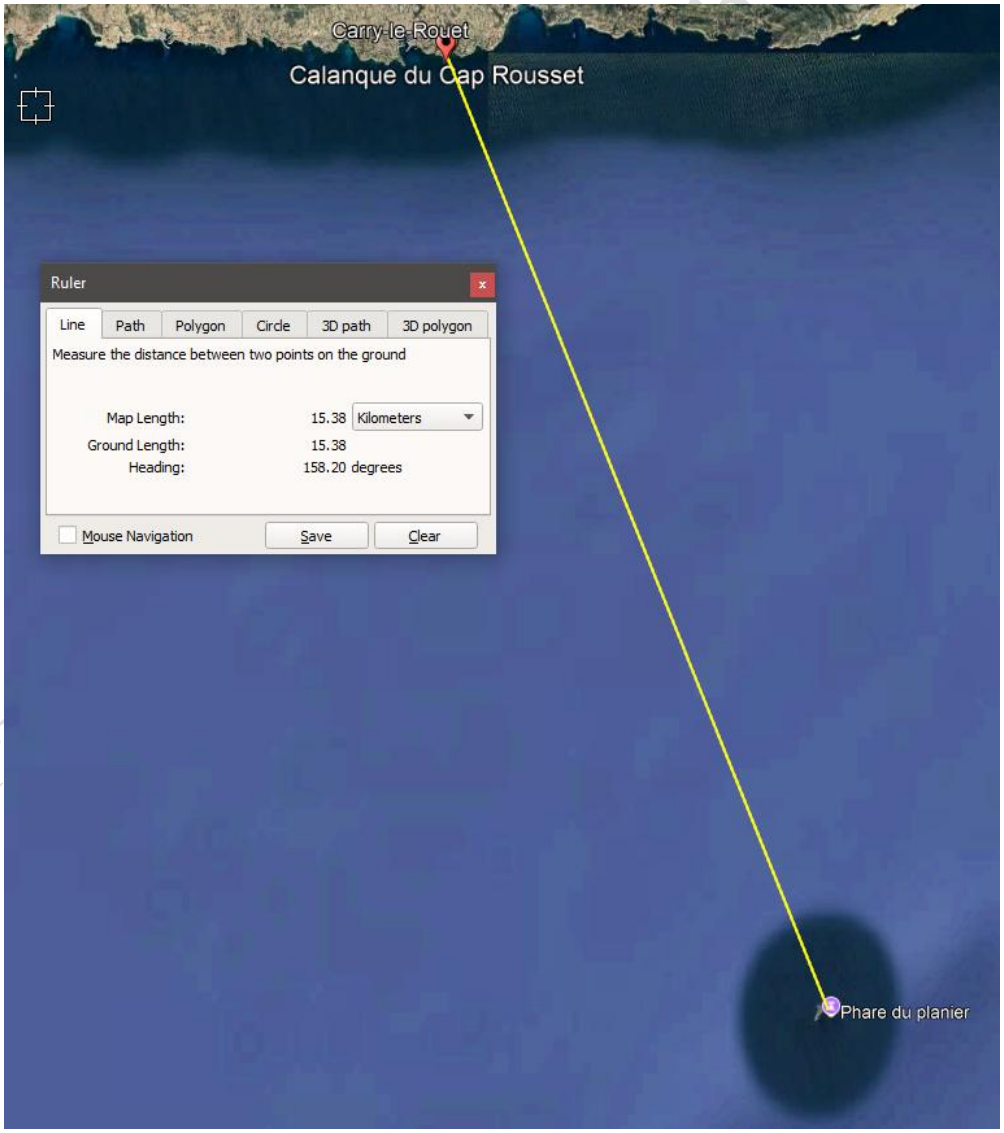
○ Imperial ◉ Metric ☐ Advanced

Distance = 21 km (21000 m), View Height = 1.8 meters Radius = 6371 km (6371000 m)

Results ignoring refraction
Horizon = 4.79 km (4789.11 m)
Bulge = 8.65 meters
Drop = 34.61 meters
Hidden= 20.62 meters
Horizon Dip = 0.043 Degrees, (0.0008 Radians)

With Standard Refraction 7/6*r, radius = 7432.83 km (7432833.33 m)
Refracted Horizon = 5.17 km (5172.83 m)
Refracted Drop= 29.67 meters
Refracted Hidden= 16.85 meters
Refracted Dip = 0.040 Degrees, (0.0007 Radians)

On the other hand, in accordance with what the Earth globe model predicts, if we change observation point to 15.59 km in the Calanque de Rousset:



The calculator gives at human height:

Earth's Curve Horizon, Bulge, Drop, and Hidden Calculator

Distance in Kilometers: 15.5

Viewer height in Meters: 1.8

Imperial Metric Advanced

Distance = 15.5 km (15500 m), View Height = 1.8 meters Radius = 6371 km (6371000 m)

Results ignoring refraction
Horizon = 4.79 km (4789.11 m)
Bulge = 4.71 meters
Drop = 18.85 meters
Hidden= 9 meters
Horizon Dip = 0.043 Degrees, (0.0008 Radians)

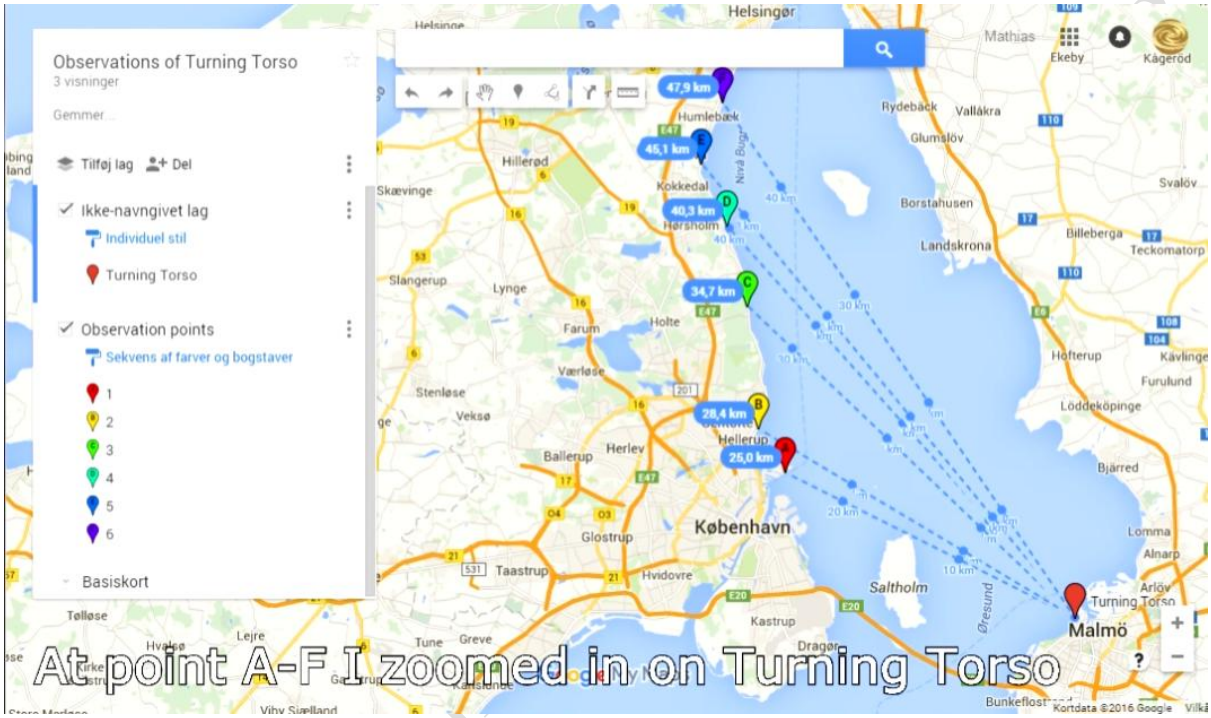
With Standard Refraction 7/6*r, radius = 7432.83 km (7432833.33 m)
Refracted Horizon = 5.17 km (5172.83 m)
Refracted Drop= 16.16 meters
Refracted Hidden= 7.17 meters
Refracted Dip = 0.040 Degrees, (0.0007 Radians)

And indeed, here is what is observed:

The building actually becomes visible! All this proves again that the Earth is not flat.

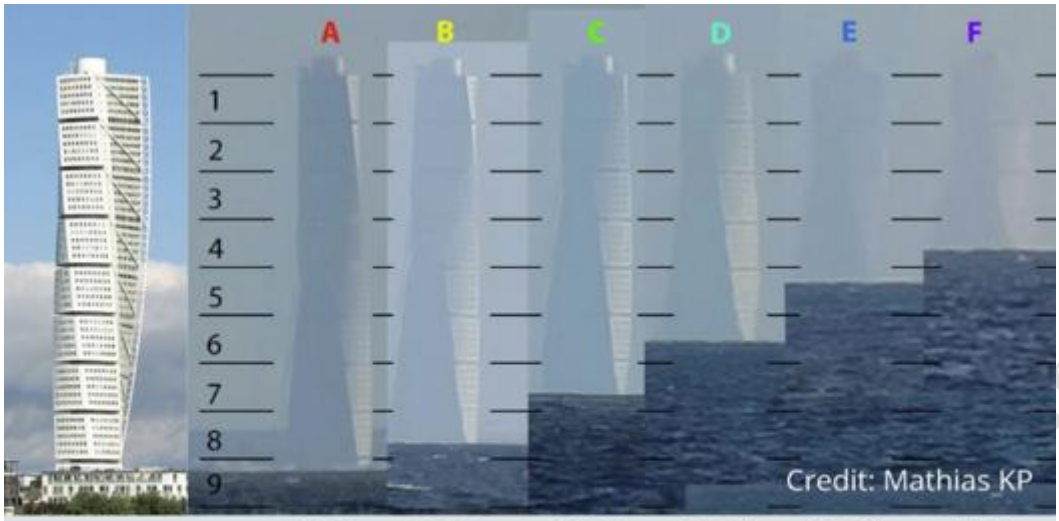
We also have the HSB Turning Torso tower, a skyscraper located in Malmö, Sweden, on the Øresund strait and directly across from Copenhagen, the capital of Denmark. It was designed by Santiago Calatrava Valls and was inaugurated on August 27, 2005. It is the tallest tower in Scandinavia. It is part of a new residential area developed on a harbor area that once stretched across the entire west of the city. It is the first skyscraper in history to have a twisted shape. The tower is 190 meters high and has 54 floors.

From Copenhagen, Denmark, we can see that its lower part is more hidden behind the curvature the further we are from the tower, and this is because the Earth is a sphere:



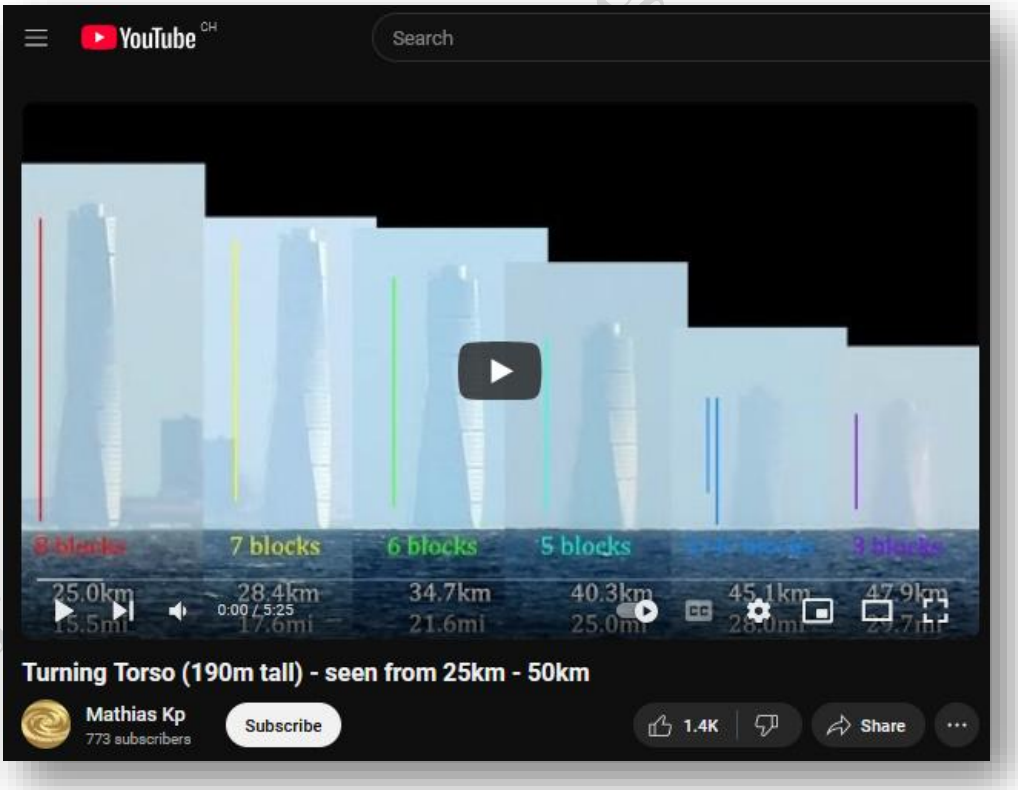
Which gives:

translation



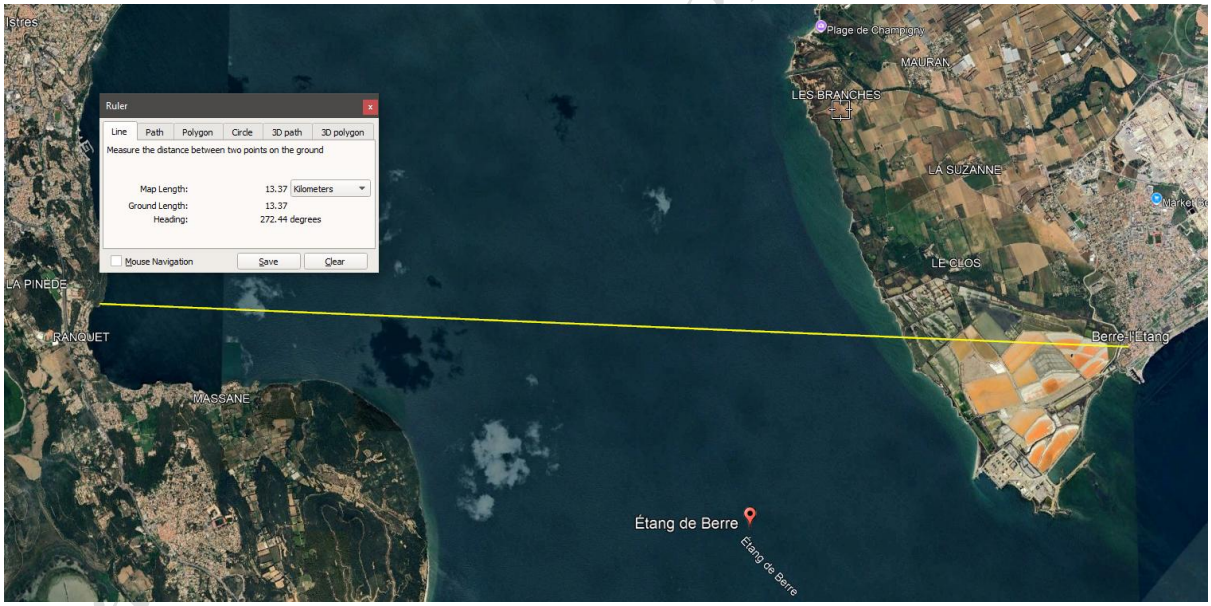
Distance	25.0 km 15.5 mi	28.4 km 17.6 mi	34.7 km 21.6 mi	40.3 km 25 mi	45.1 km 28 mi	47.3 km 29.8 mi
Height	3.7 m 12.1 ft	2.9 m 9.5 ft	2.9 m 9.5 ft	2.4 m 7.9 ft	2.7 m 8.9 ft	2.1 m 6.9 ft
Observer						

The original YouTube video is here:

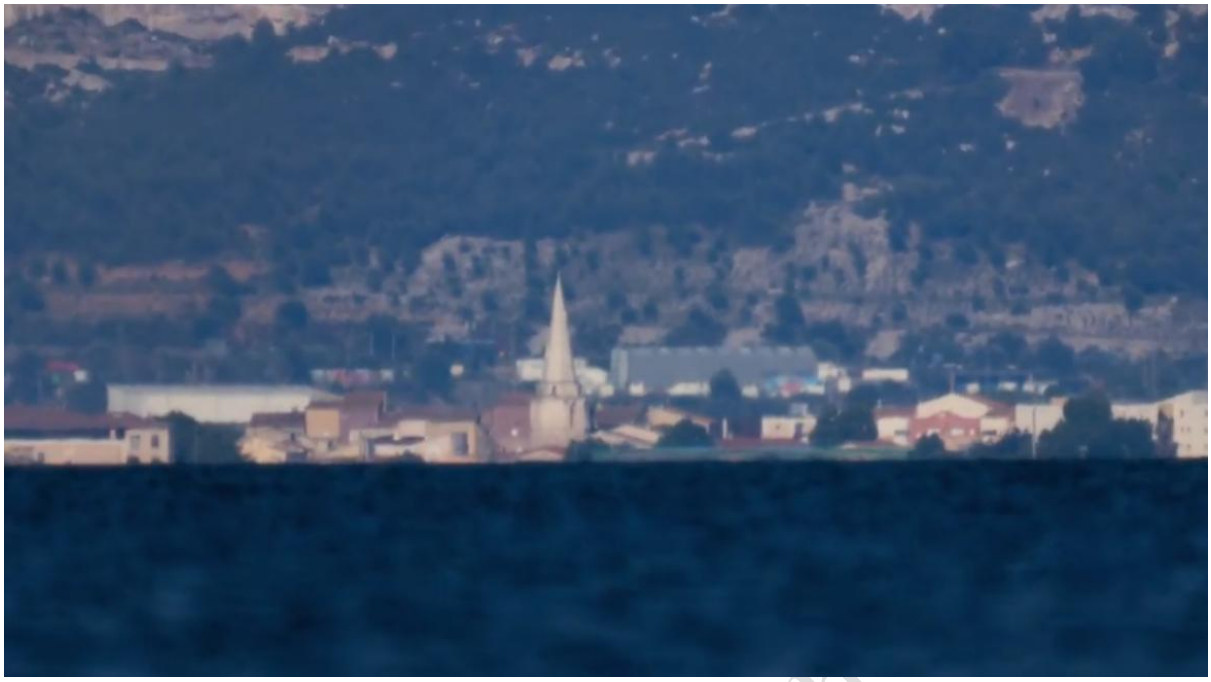


Now, still from Olivier Joseph (https://www.youtube.com/watch?v=6zBWh6c22J4), let's see now another proof of the curvature from the Étang de Berre with the Canon EOS with a CelestronC90 telephoto lens at 60 cm above the water level:

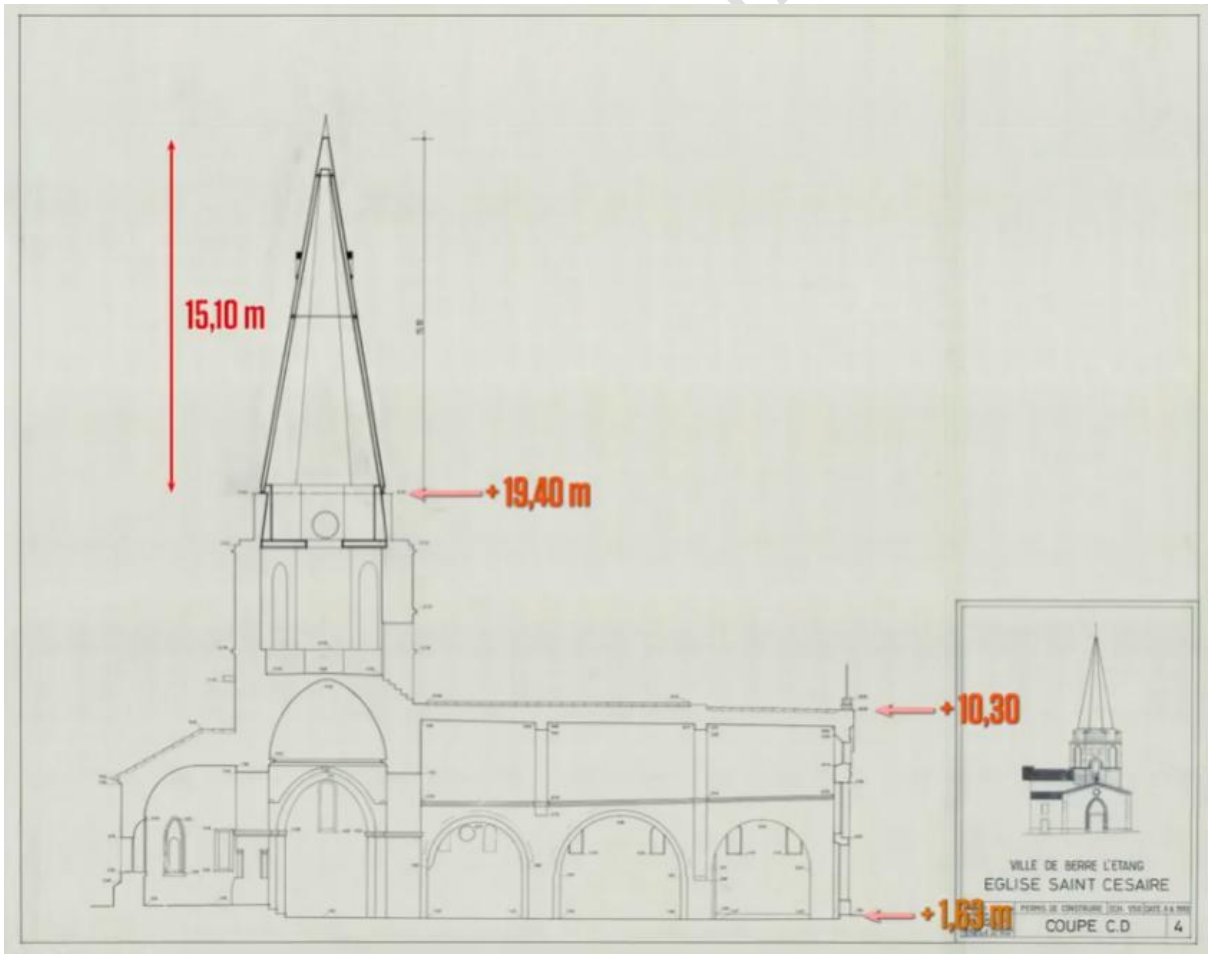
Located near Ranquet beach towards the church of Saint-Césaire du Berre-l'Étang:



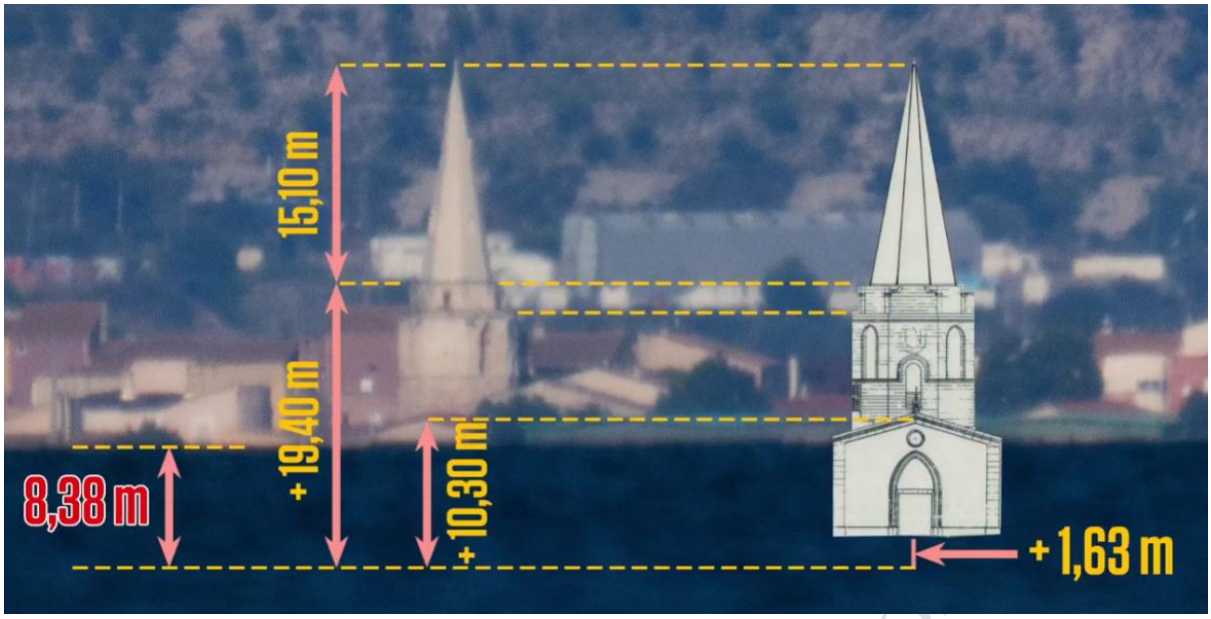
We get :



By asking the town hall for the plan of the church, we have:



Reported in the photo, we have:



So 8.38 meters is below the horizon which is consistent with what we would expect from the spherical Earth with average refraction:

Earth's Curve Horizon, Bulge, Drop, and Hidden Calculator

Distance in Kilometers: 13.37

Viewer height in Meters: 0.6

○ Imperial ◉ Metric ☐ Advanced

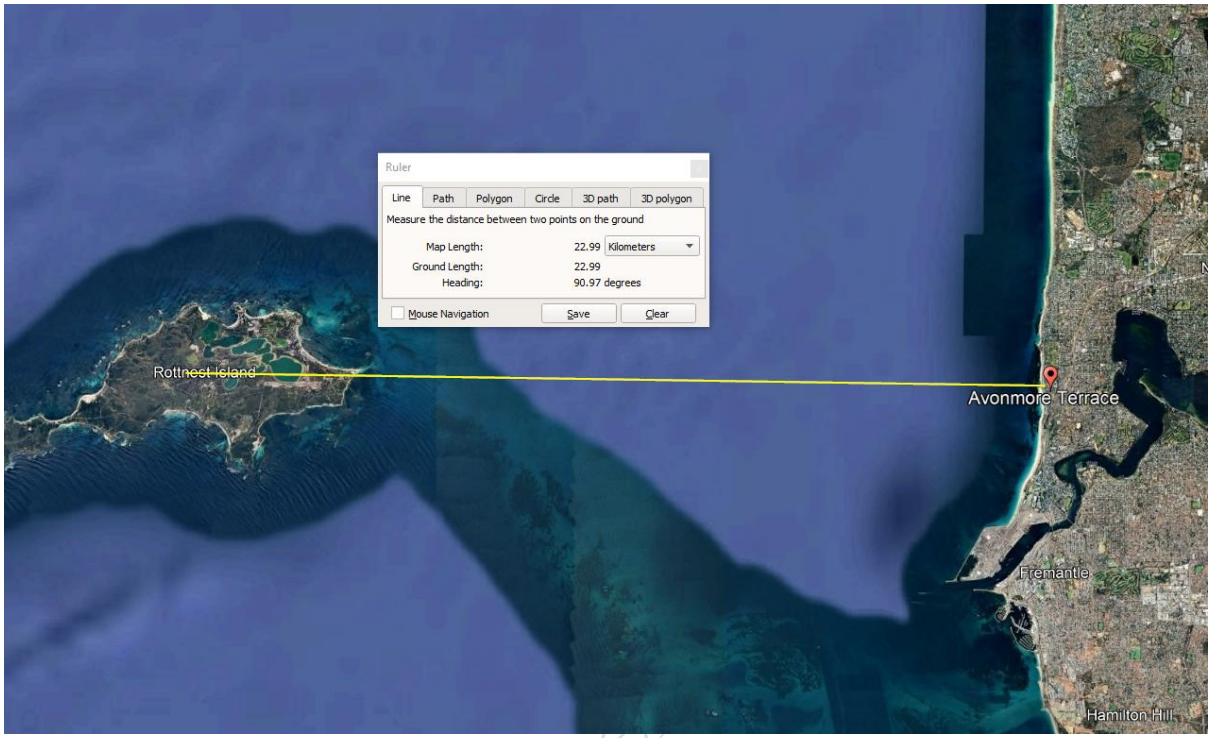
Distance = 13.37 km (13370 m), View Height = 0.6 meters Radius = 6371 km (6371000 m)

Results ignoring refraction
Horizon = 2.76 km (2765 m)
Bulge = 3.51 meters
Drop = 14.03 meters
Hidden= 8.83 meters
Horizon Dip = 0.025 Degrees, (0.0004 Radians)

With Standard Refraction 7/6*r, radius = 7432.83 km (7432833.33 m)
Refracted Horizon = 2.99 km (2986.54 m)
Refracted Drop= 12.02 meters
Refracted Hidden= 7.25 meters
Refracted Dip = 0.023 Degrees, (0.0004 Radians)

We also have the view from Cottesloe in Perth, Australia, looking towards Rottnest Island.

The location is Princes St. Cottesloe from the top near Avenmore Terrace and from the bottom on the beach:

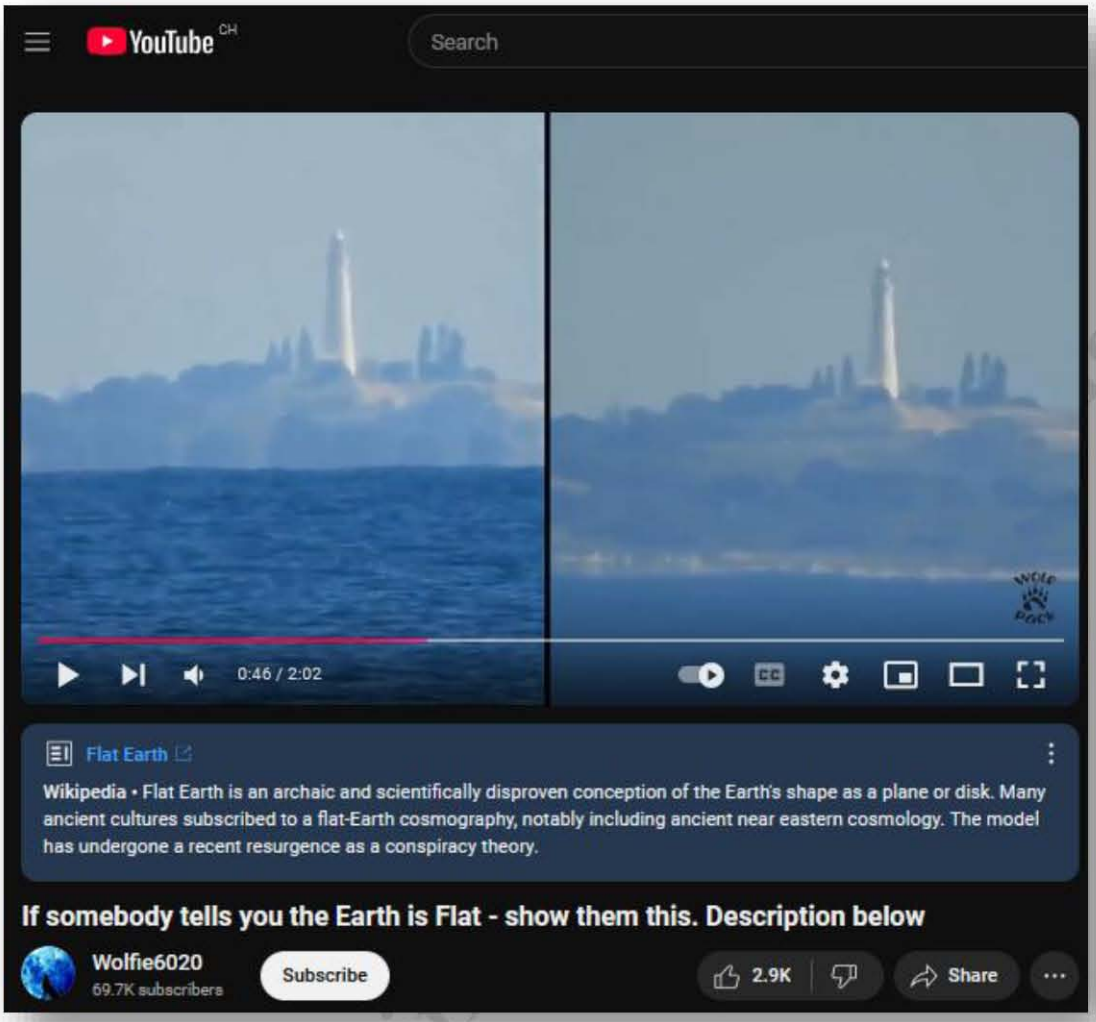


The two videos below were taken a few minutes apart. The left frame below shows the view from 2 meters above sea level. The right frame is from 30 meters above sea level.

You can clearly see how much the island is hidden by the curvature of the Earth at the lowest altitude:

https://www.youtube.com/watch?v=WIhv8dMZWeI

translation into e


YouTube CH
Search
0:46 / 2:02
Flat Earth
Wikipedia • Flat Earth is an archaic and scientifically disproven conception of the Earth's shape as a plane or disk. Many ancient cultures subscribed to a flat-Earth cosmography, notably including ancient near eastern cosmology. The model has undergone a recent resurgence as a conspiracy theory.
If somebody tells you the Earth is Flat - show them this. Description below
Wolfie6020
69.7K subscribers
Subscribe
2.9K
Share

translation in progress

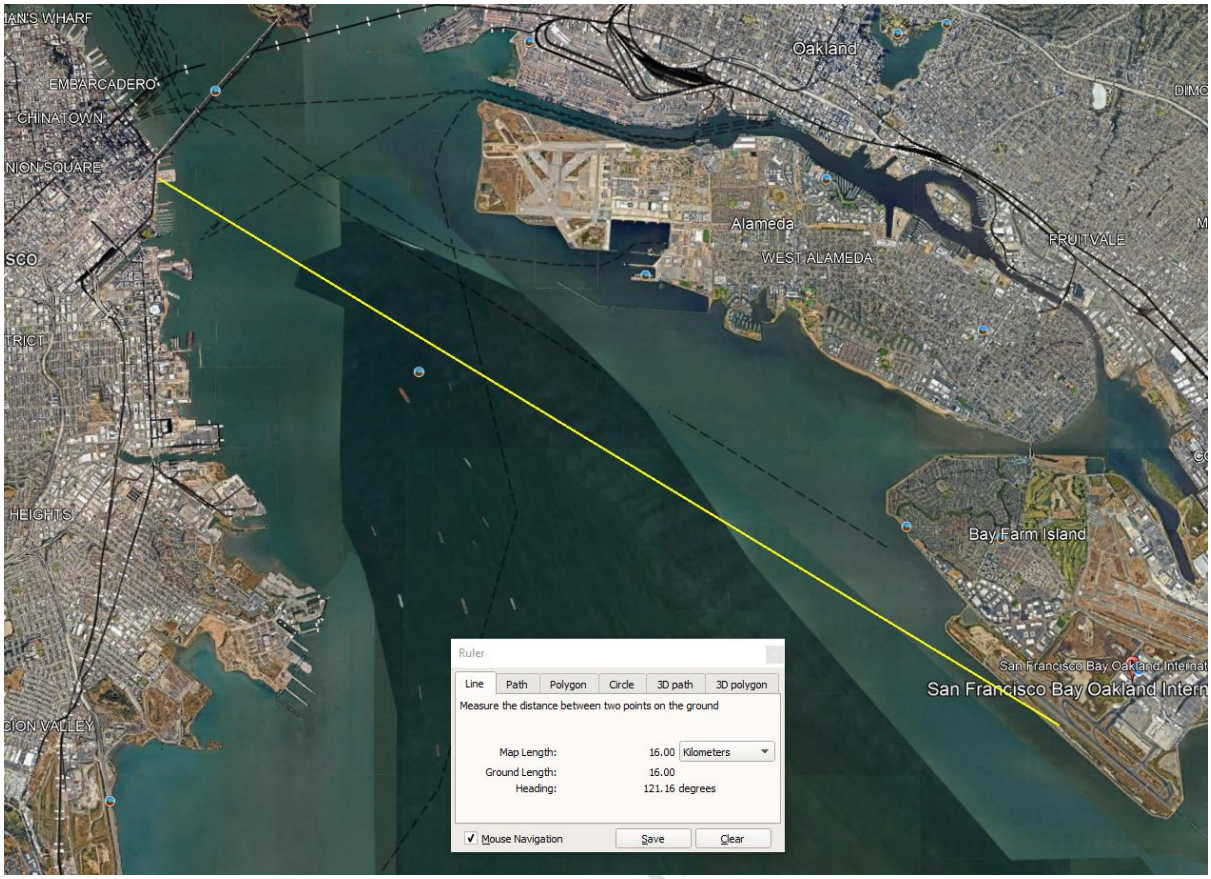
(#062) Planes disappearing below the horizon upon landing

Mosaic of an airplane landing and taking off from Oakland International Airport (37°42'40.76"N, 122°13'54.23"W), as seen from across San Francisco Bay, 16 km away in ATA Park on February 24, 2018. The planes appear to be well below the horizon when on the runway. This proves that the ocean surface is curved and contradicts the assumption that the surface is flat:

Figure 39 Plane landing and taking off from Oakland International Airport (author: Scott McPeak)

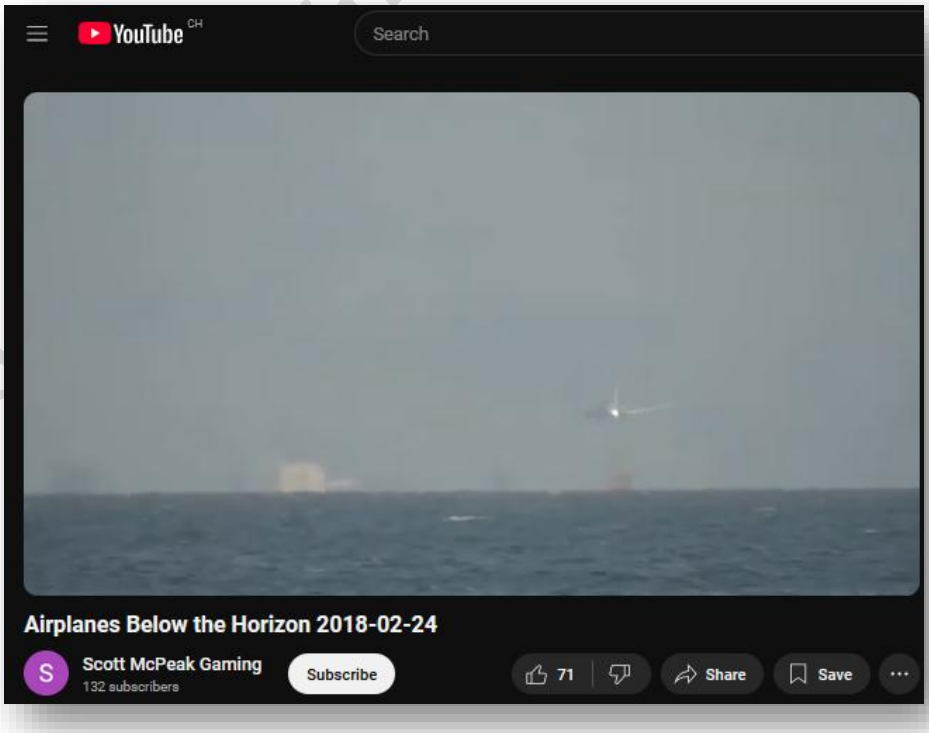
Here is the context:

translation int



The original video is here:

https://www.youtube.com/watch?v=EtC6vTuhQ1g



(#063) Helicopter disappearing below the horizon upond landing

In the video of PBS Learning Media from the 2015 series *Genius by Stephen Hawking* we have the evidence that a Helicopter is under the curve:

https://www.pbslearningmedia.org/resource/hawking_genius_ep06_clip01/where-are-we-ch-1-the-circumference-of-the-earth-genius-by-stephen-hawking/

Using a Celestron nexstar 8:

It is crystal clear in this video that as the waves on the sea are negligeable and that there or no canyons where the Helicopter can hide. Therefore the disappearance of the Helicopter is due to Earth's curvature! This proves again that the Earth is not flat!

Simple empirical experiments for the curvature of the Earth

There are dozens of famous and simple experiments dedicated solely and directly to the curvature of the Earth. Here we will list the most well-known ones that are empirical, repeatable, measurable, controllable, verifiable, calculable, and undebunkable!

(#064) Eratosthenes' experiment (Alexandria-Syene)

Eratosthenes (ancient Greek polymath: mathematician, geographer, poet, astronomer, and music theorist), born around 276 BC in Cyrene and died around 194 BC in Alexandria, who according to legend measured the angle of shadow to determine the circumference of the Earth using only two measuring points in Alexandria and Syene, as he already knew that the Earth was a sphere (in the 2nd century BC):

$$R_{\text{Terre}} = \frac{\ell}{\Theta} \approx 6'266 \text{ km}$$

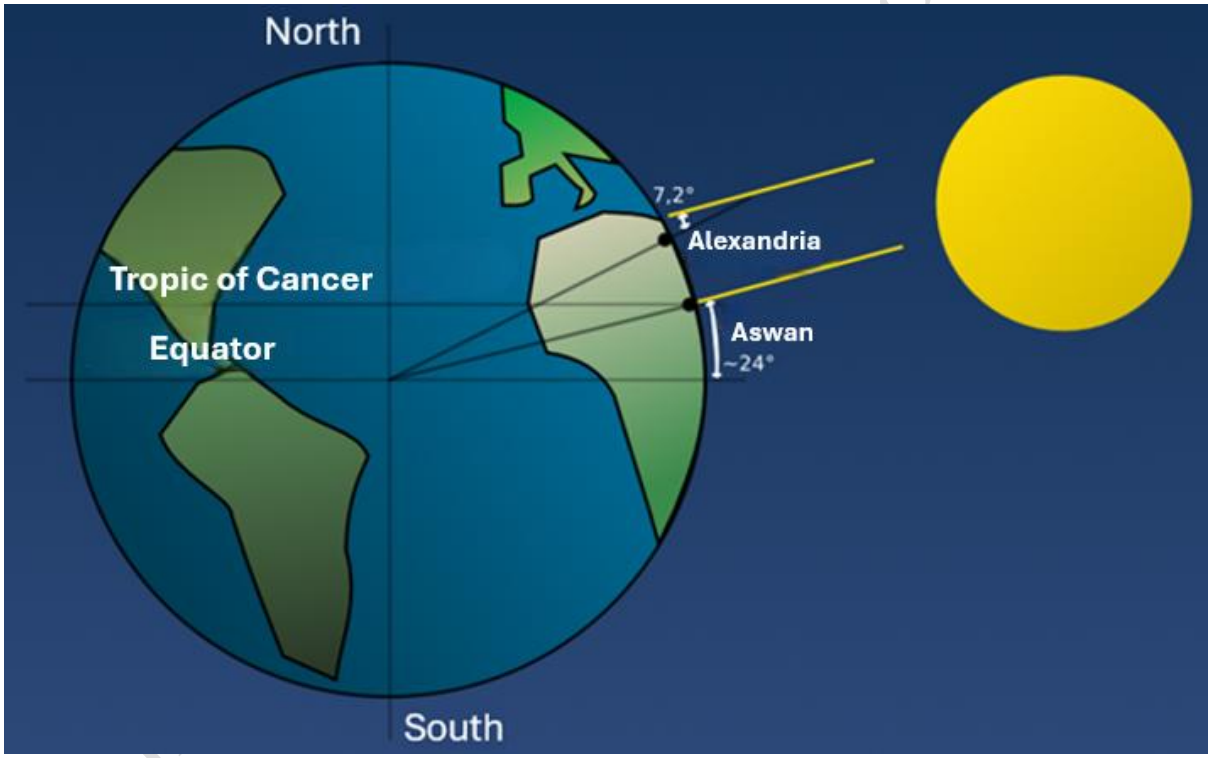


Figure 40 Illustration (not to scale and simplified) of Eratosthenes' experiment (author: Raphael Javaux, source: Wikipedia)

Flat Earth proponents are not wrong when they claim that the original experiment did not prove that the Earth is round. But we can modify the experiment to use three or more measurement points.

Eratosthenes World School Annual Project

However, more than **5,877 schools** on five continents in **105 countries** have carried out more than **5,000 measurements** since 2005, this is the "Eratosthenes project", and the flat Earth model is instantly refuted by this global community experiment (Eratosthenes 2009/2010: An old experiment in modern times, 2011).

You can find information about the Eratosthenes Project here:

https://eratosthenes.ea.gr/

Figure 41 Schools and students participating in the global Eratosthenes project (source: https://fondation-lamap.org/en/participez/the-eratosthenes-project)

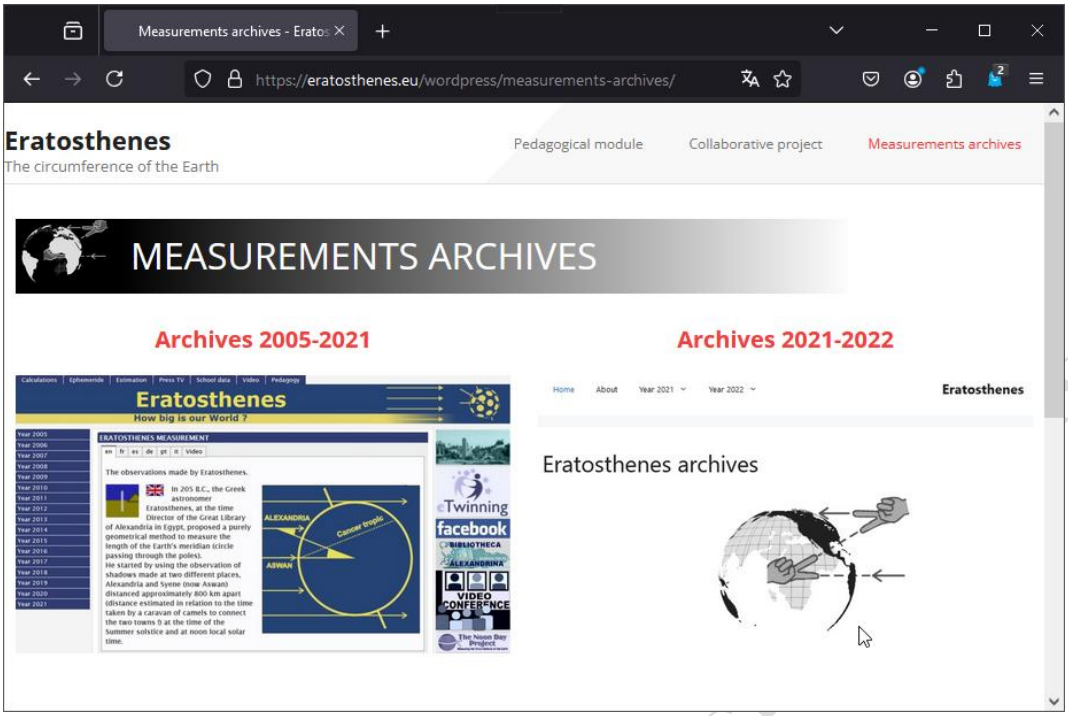
And also here:

https://eratosthenes.eu/wordpress/

and all the archives of measurements over the last twenty years here:

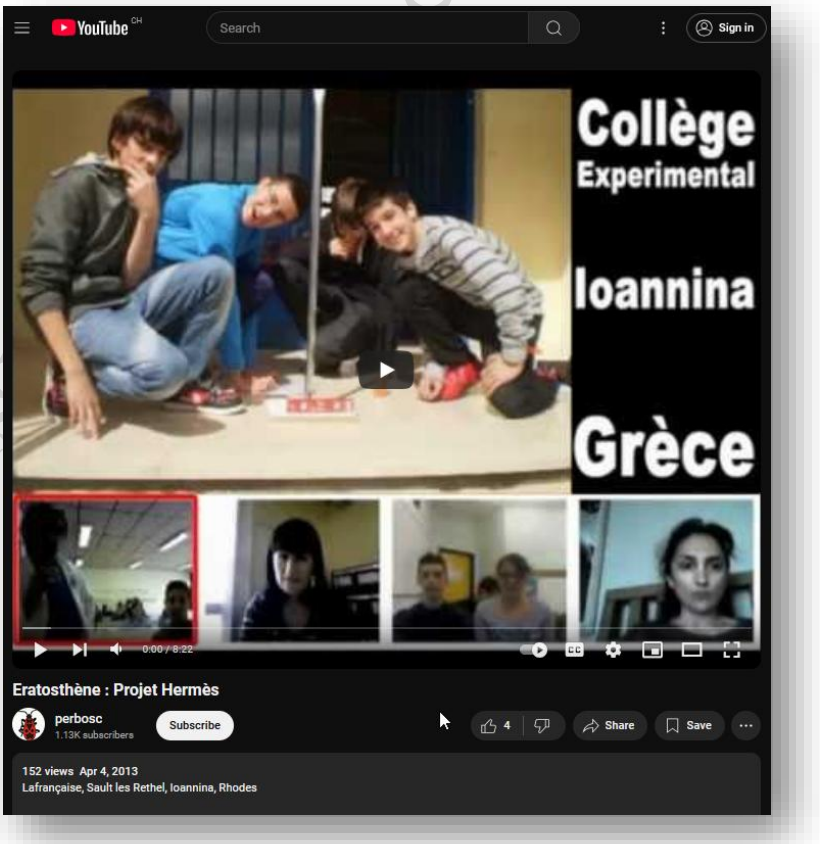
https://eratosthenes.eu/wordpress/measurements-archives/

translation into eng



The experience with a very small number of schools and the detailed, filmed and illustrated calculations are available for example in the French-language video available here:

https://www.youtube.com/watch?v=OzgAuGDhflM



(#065) Al Biruni's Experience (Pakistan)

The 11th-century Persian mathematician and Islamic (i.e., Sunnite Muslim) scholar Abu Rayhan al-Biruni used simple trigonometric results to estimate the radius of curvature of the Earth.

Figure 42 Statue of al-Biruni in Iran - a Shia majority country (note the globes...)

Al-Biruni measured the Earth's radius from a hill near Nandana Fort, located in present-day Punjab province of Pakistan.

translation into English

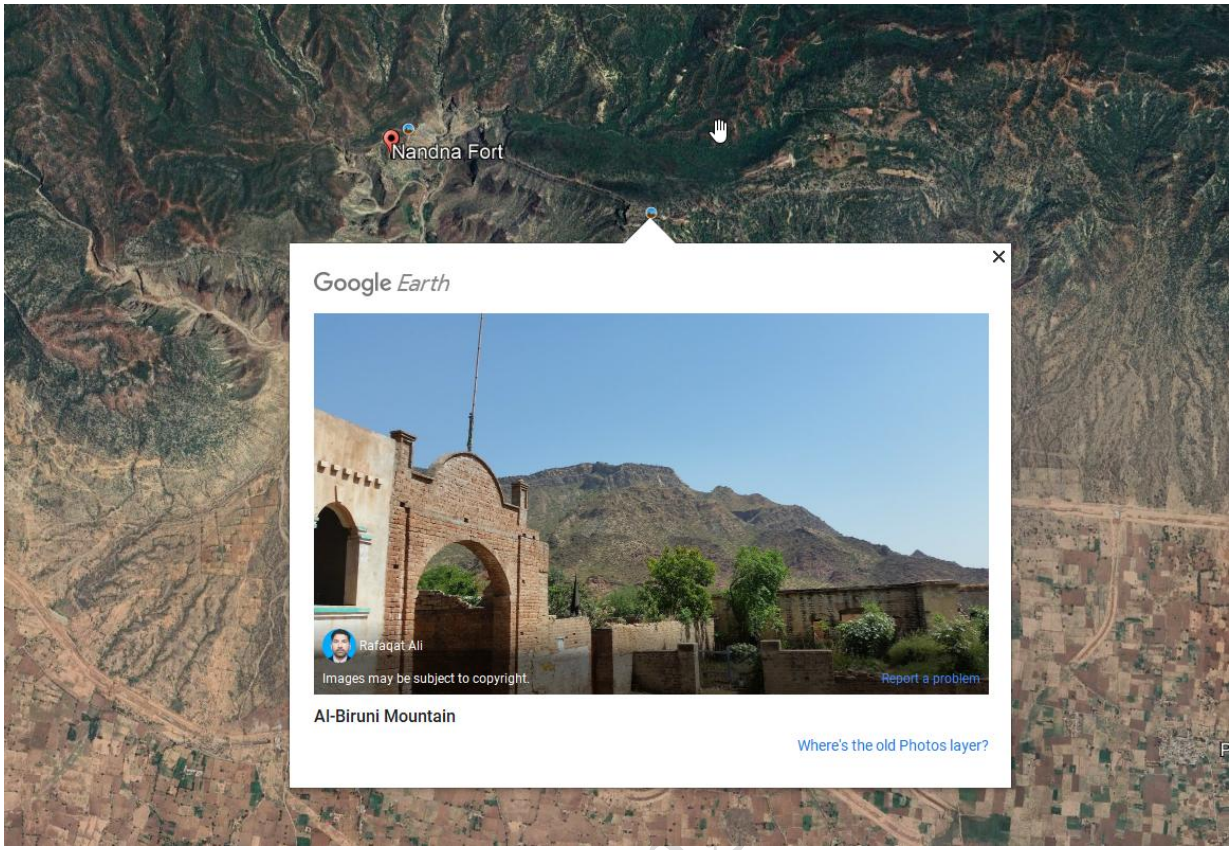
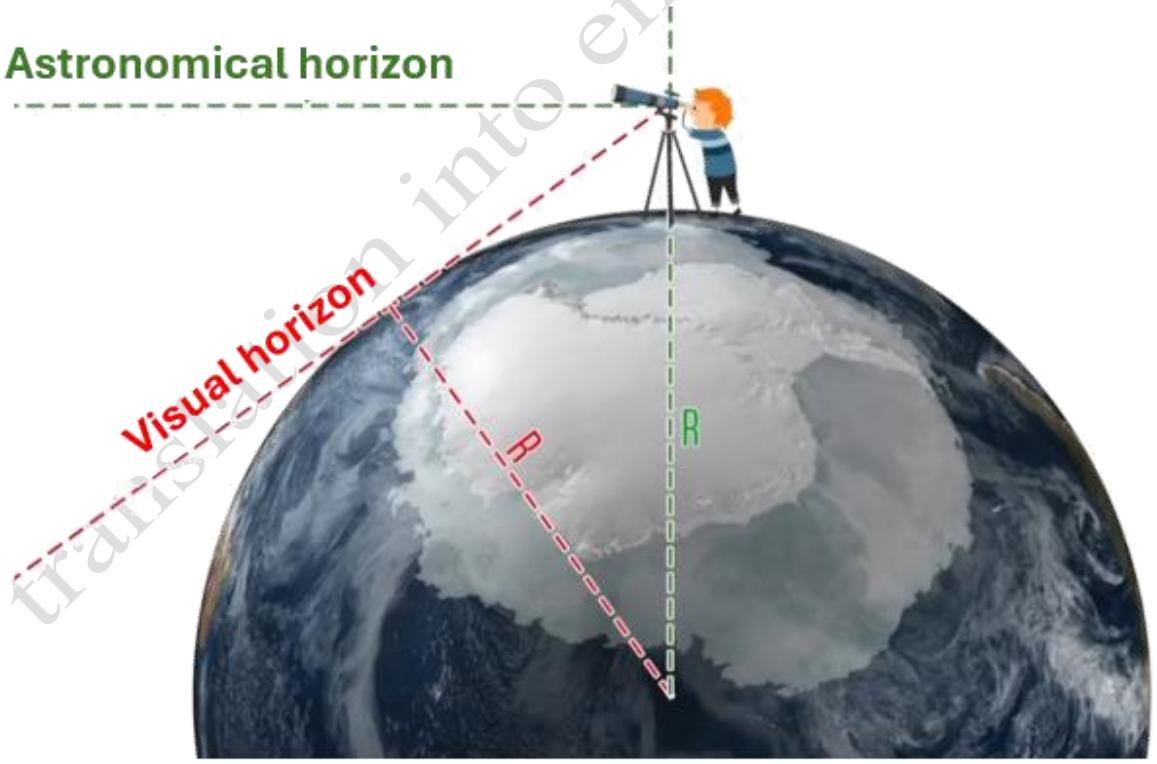


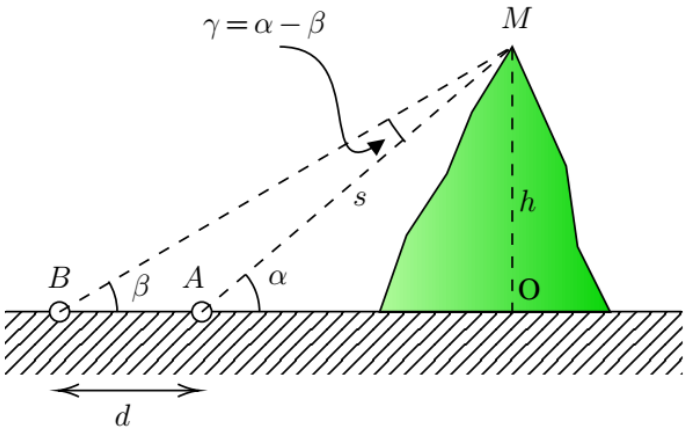
Figure 43 Down from Nandana Fort

Figure 44 Archaeological remains of the present Nandana Fort

He used a method involving measuring the height of the hill and the angle of depression toward the horizon to calculate the radius of the Earth.



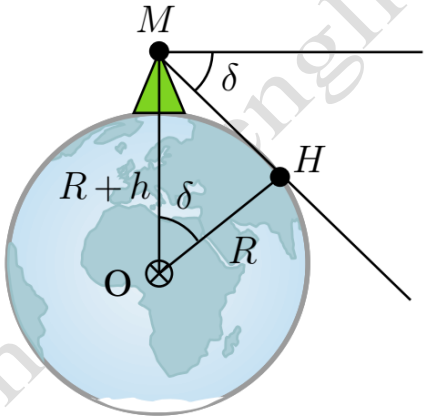
His estimate is 6,340 kilometers, which is within 1% of the average radius of 6,371 kilometers.



With:

$$h = \left(\frac{\tan(\alpha)tan(\beta)}{\tan(\alpha) - tan(\beta)}\right) d$$

And on the configuration of (δ is the depression angle):



With basic trigonometry we have:

$$R = \frac{\cos(\delta)}{1 - \cos(\delta)} h$$

This is how, using simple trigonometry, Al Biruni was able to determine the radius of curvature of 6,340 kilometers.

translation english ongoing

(#066) Bedford Level Experiment (United-Kingdom)

The Bedford Level Experiment was a series of observations made along the 10-kilometre-long Old Bedford River near Bedford in the Fens of Cambridgeshire, UK, during the 19th and early 20th centuries to measure the curvature of the Earth:

Figure 45 Old Bedford River (source: Wikipedia)

Samuel Rowbotham, who made the first observations starting 1838, claimed to have proven that the Earth was flat. However, in 1870, after adjusting Rowbotham's method to account for the effects of atmospheric refraction, Alfred Russel Wallace found a curvature consistent with a spherical Earth (The Rotundity of the Earth, 1870).

translation ongoing

(#067) Rainy Lake Experience (USA-Canada)

The Rainy Lake experiment was designed to demonstrate how we can determine the shape of the Earth, flat or globe-shaped, by observing and measuring a clever arrangement of targets over a distance of 10 kilometers, taking into account Earth refraction, and using modern equipment.

Rainy Lake is a relatively large freshwater lake (930 km^2) located on the border between the United States and Canada. Rainy Lake is part of an extremely large system of lakes that forms the Hudson Bay drainage basin, which extends from western Lake Superior to the Arctic Ocean.

The experiment is an advanced version of the Bedford Level experiment conducted in 1838. The experiment leads to the conclusion that the Earth must be a globe with a radius of 6,371 km.

Although the overall experiment was primarily the work of George Hnatiuk, Jesse Kozlowski and Soundly joined him in early April 2018 to take GPS measurements (Jesse), images, and videos (Soundly) of the experiment. Later, Walter Bislin created a computer model of the experiment, visualized the data in his GNSS (Global Navigation Satellite System) data viewer, and wrote this report.

During the winter months until May, the lake is covered in a meter-thick layer of ice. The lake was chosen for this experiment because George Hnatiuk lives right next to the lake and is equipped with the tools and vehicles needed for the experiment, such as a snowmobile. The lake offers a clear path of approximately 10 kilometers from George's house to a small island called Home Island, which is ideal for this experiment.

Figure 46 Panorama of Rainy Lake in winter 2018 with George Khan's dog next to the snowmobile

The raw data from the experiment are given here:

http://walter.bislins.ch/bloge/index.asp?page=Rainy+Lake+Experiment%3A+Location+Graph+and+Data

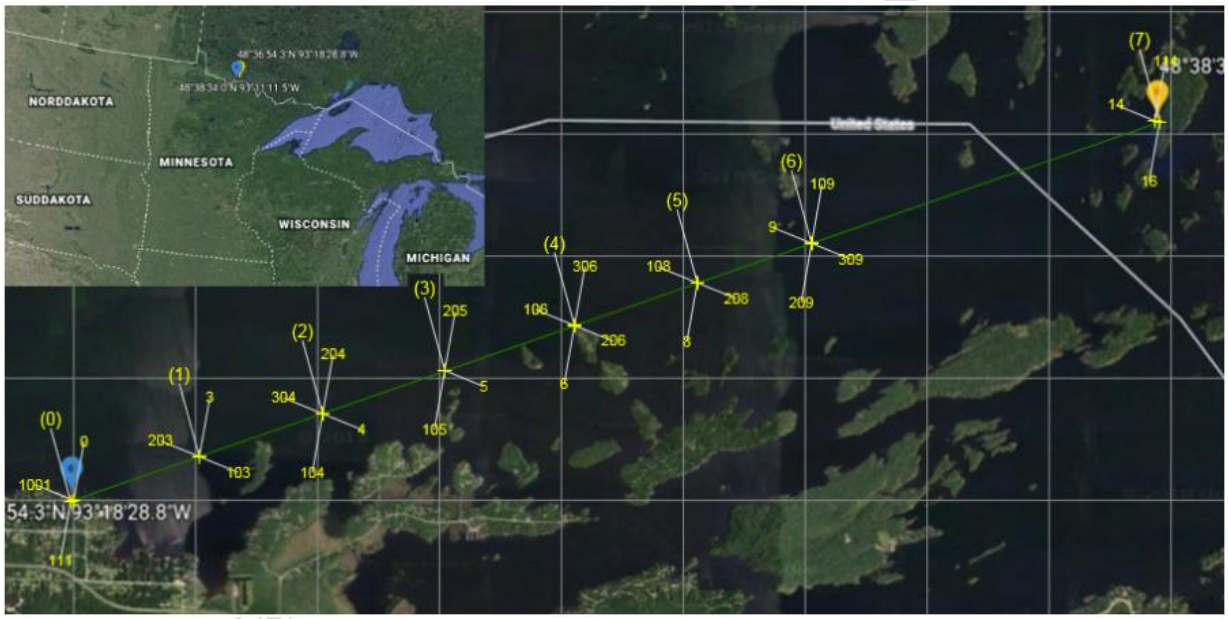


Figure 47 Rainy Lake Target Locations for the experiment

(#068) Argentic photo of the curvature with a stratospheric balloon in 1932

Albert William Stevens (1886–1949) was a United States Army Air Force officer, balloonist, and pioneering aerial photographer. In 1935, he and Captain Orvil Anderson made a record-breaking balloon flight, reaching an altitude of 22,066 meters (72,000 feet), a record that stood until 1956.

On November 11, 1935, Albert W. Stevens carried a specially designed infrared camera to an altitude of 22,066 meters above South Dakota in the stratospheric balloon *Explorer II*. He took the first photo of the Earth's curvature from left to right. This photo was published in the May 1936 issue of the journal National Geographic:

The photo was taken with a Fairchild K17 camera equipped with a Kodak 304mm f/5 lens on Eastman Aero infrared film with a red filter. The film is 9″ wide for a large format photograph:

translation pending

Figure 48 Albert W. Stevens' 1935 film photograph of the Earth's curvature

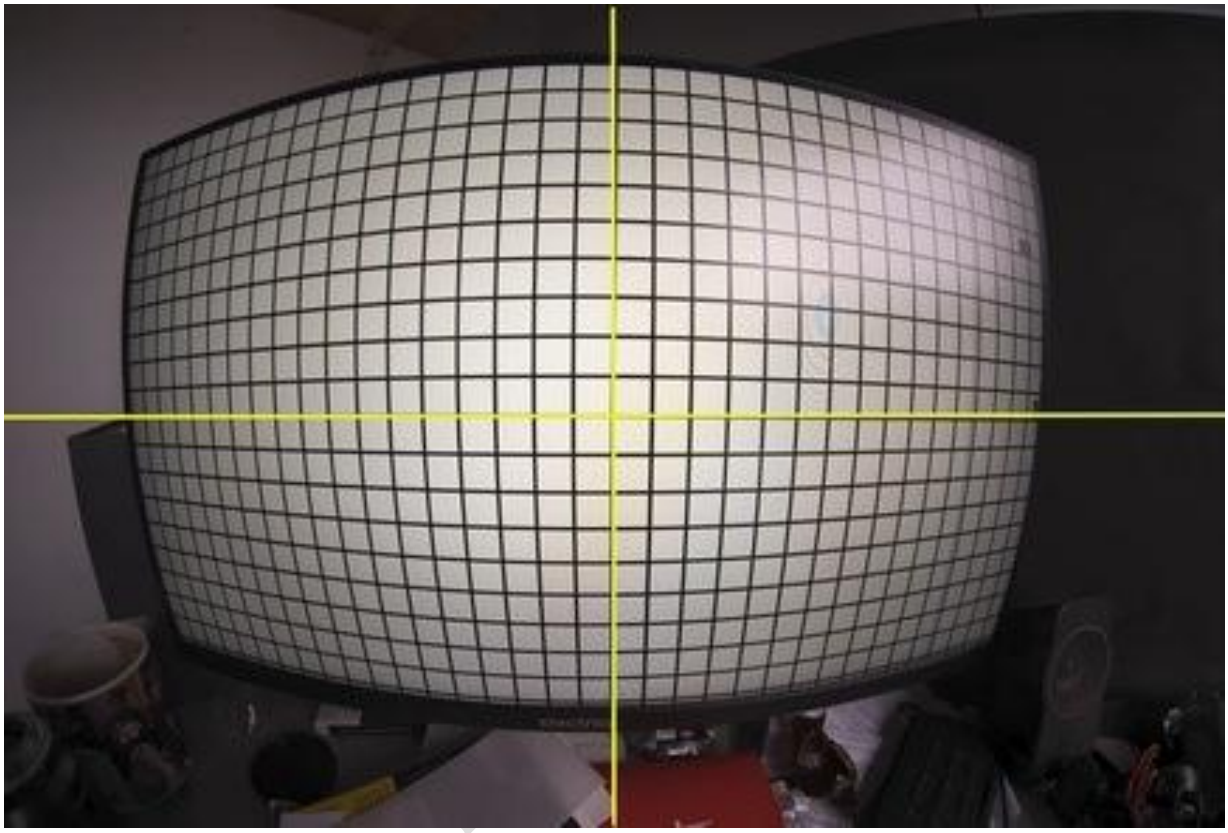
The high-resolution PDF scan is available here:

https://mctoon.net/wp-content/uploads/2022/12/1935-sdakota.pdf

The camera used was relatively large as can be seen in the Museum photos:

(#069) Photo of the curvature with a weather balloon and GoPro camera

Anyone can verify that current GoPro camera models do indeed have a fisheye lens and that these, like any standardized fisheye lens, do not distort the central vertical line or the central horizontal line as shown in the photo on this screen where an image with a grid has been put in full screen:



Detailed protocol available here:

https://meprises-du-ciel.fr/stratos

Let's summarize it a little in case the website disappears in a few years!

On Monday, July 31, 2017, at 11:25 a.m., a stratospheric balloon was released from the small town of St. Etienne de Villeréal in the Lot & Garonne region of France. The team involved included Christophe Content, Christophe Lucas, Valensi Flavien, and other members of the Méprise Du Ciel club.

The flight chain included:

- A 1600gr/110€ balloon (http://randomsolutions.co.uk/Random_Aerospace/Balloons.html)
- A parachute (price not disclosed)
- A radar reflector (40€)

- A GPS (14-20€)
- A multi-sensor “High Altitude computer” card (GPS coordinates, temperature, pressure, altitude)
- A basket with on board:
    - A Go Pro 4 (obviously with a standardized fisheye lens)
    - A dosimeter (Geiger counter)
    - A small figurine
    - A radiosonde (flight tracking with GPS coordinates and altitudes in real time)

There are complete kits for €600:

https://www.stratoflights.com/en/shop/weather-balloon-kit/

Weather Balloon Kit

(5 customer reviews)

Item number: 100600

529,00 €

incl. 19% VAT plus **shipping costs**

In stock

Delivery time: 3-5 days*

Worldwide shipping

Weather Balloon 1600 / Parachute 2500

no second GPS Tracker

no Datalogger

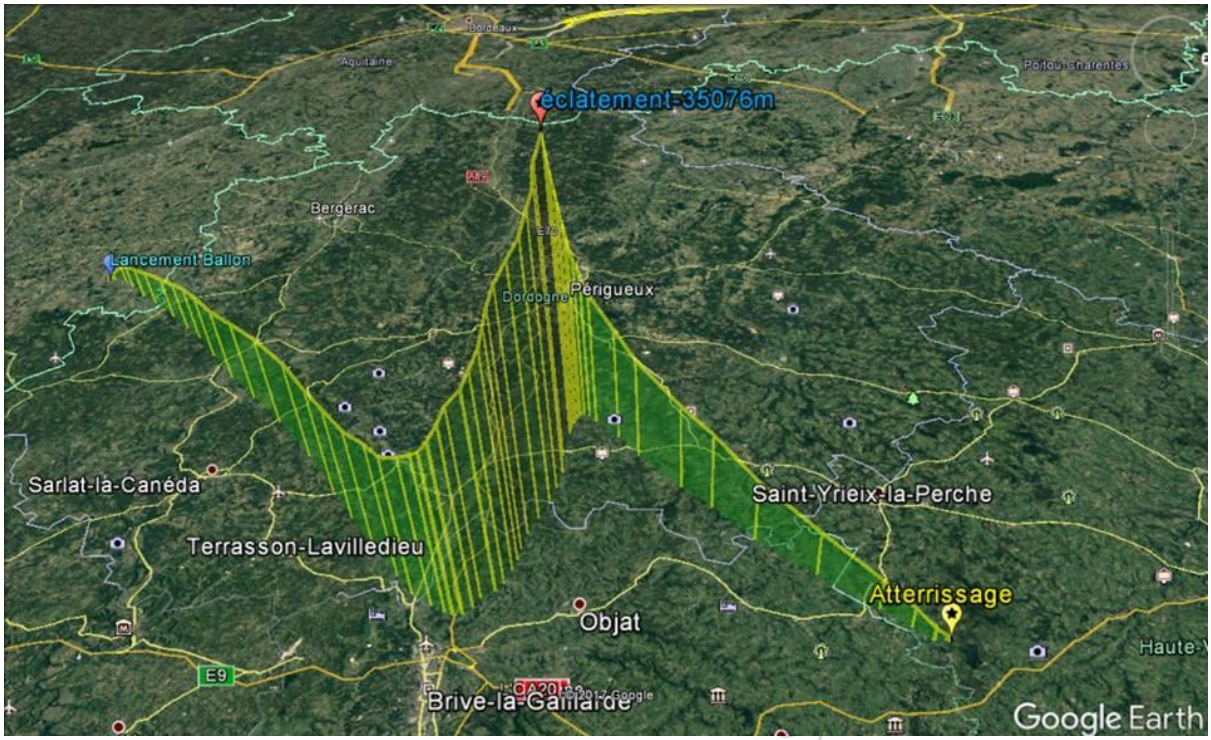
no Space Cam

no STRATOlab Experiment mount

1 Add to cart

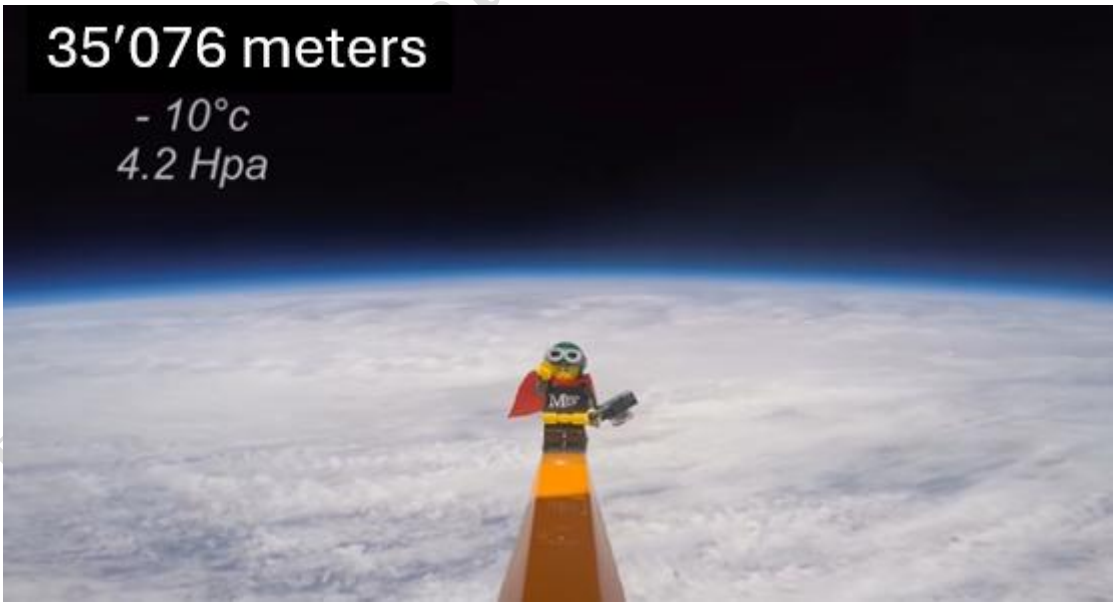
Prepayment Billing PayPal SOFORT VISA

Release route:



And for those who prefer a video and observe when the horizon line passes through the horizontal axis of symmetry of the fisheye lens in order to see that the curvature of the Earth is factual since any horizontal line that passes through the horizontal axis of symmetry of the lens is not distorted:

https://www.youtube.com/watch?v=iPT5MmxWThs&t=2s



(#070) Distance from the local Sun and elementary trigonometry

There is also another problem with the flat Earth model! Indeed, flattards claim – without proof because flattards have no scientific measurements or mathematical models… – that the Sun should be at an altitude of about 5,000 kilometers and should have a diameter of about 51 kilometers (Sun is a light 32 Miles Across, 1978) and that it is impossible for it to be much further away.

However, simple observations that everyone can repeat, such as those made by Aristarchus of Samos (https://en.wikipedia.org/wiki/Aristarchus_of_Samos), who lived between approximately 310 and 230 BCE, contradict this statement as detailed here:

https://en.wikipedia.org/wiki/On_the_Sizes_and_Distances_(Aristarchus)

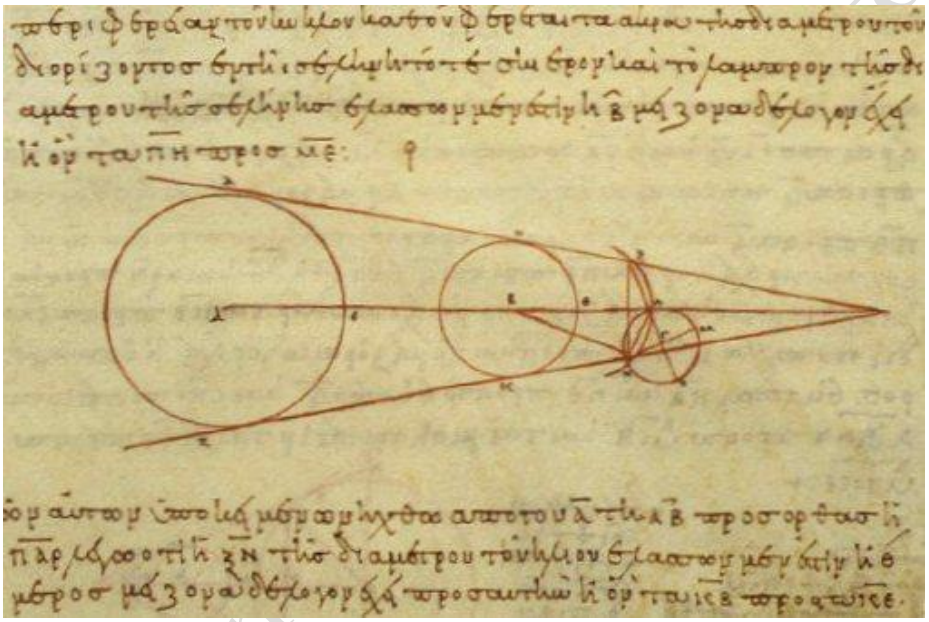


Figure 49 Aristarchus's calculations of the relative sizes of the Sun, Earth, and Moon, 3rd century BC, from a 10th-century Greek copy (source: Wikipedia)

If the Wikipedia page is not detailed enough, there is a much more detailed version in (Opera Magistris, 2024) with a detailed mathematical proof and numerical values.

From Aristarchus' method (and anyone who replicates the experiment) we obtain the following estimates based on the average radius of the Earth (6,303 kilometers) as obtained by Al-Biruni (11th century) and Eratosthenes (2nd century BCE):

- Estimated diameter of the Moon according to Aristarchus' method: 4,397 kilometers
- Estimated diameter of the Sun according to Aristarchus' method: 83,964 kilometers
- Earth-Moon distance according to Aristarchus' method: 500,000 kilometers
- Earth-Sun distance according to the Aristarchus method: 9,547,919 kilometers

translation pending

These values, which anyone can reproduce experimentally and inject into the geometric relationships described and demonstrated in the various sources mentioned above, therefore contradict the assertions and beliefs of the flat Earth supporters!

translation into english ongoing

(#071) Horizon-o-Matic

The “Horizon-o-Matic” experiment has two straight edges fixed together with a gap between them. This allows the horizon to be photographed between the two straight edges. By examining the photograph, we can be sure that the straight edges are truly straight and that any curve identified between them is a real curve.

Here is an example of the setup before aligning the horizon between the right edges:

Figure 50 The Horizon-o-Matic experiment (source: https://mctoon.net)

The high resolution photo is available here:

https://mctoon.net/wp-content/uploads/2019/05/30-horizon-o-matic-baseline.jpg

Here is the setup with the horizon carefully aligned between the straight edges:

translation

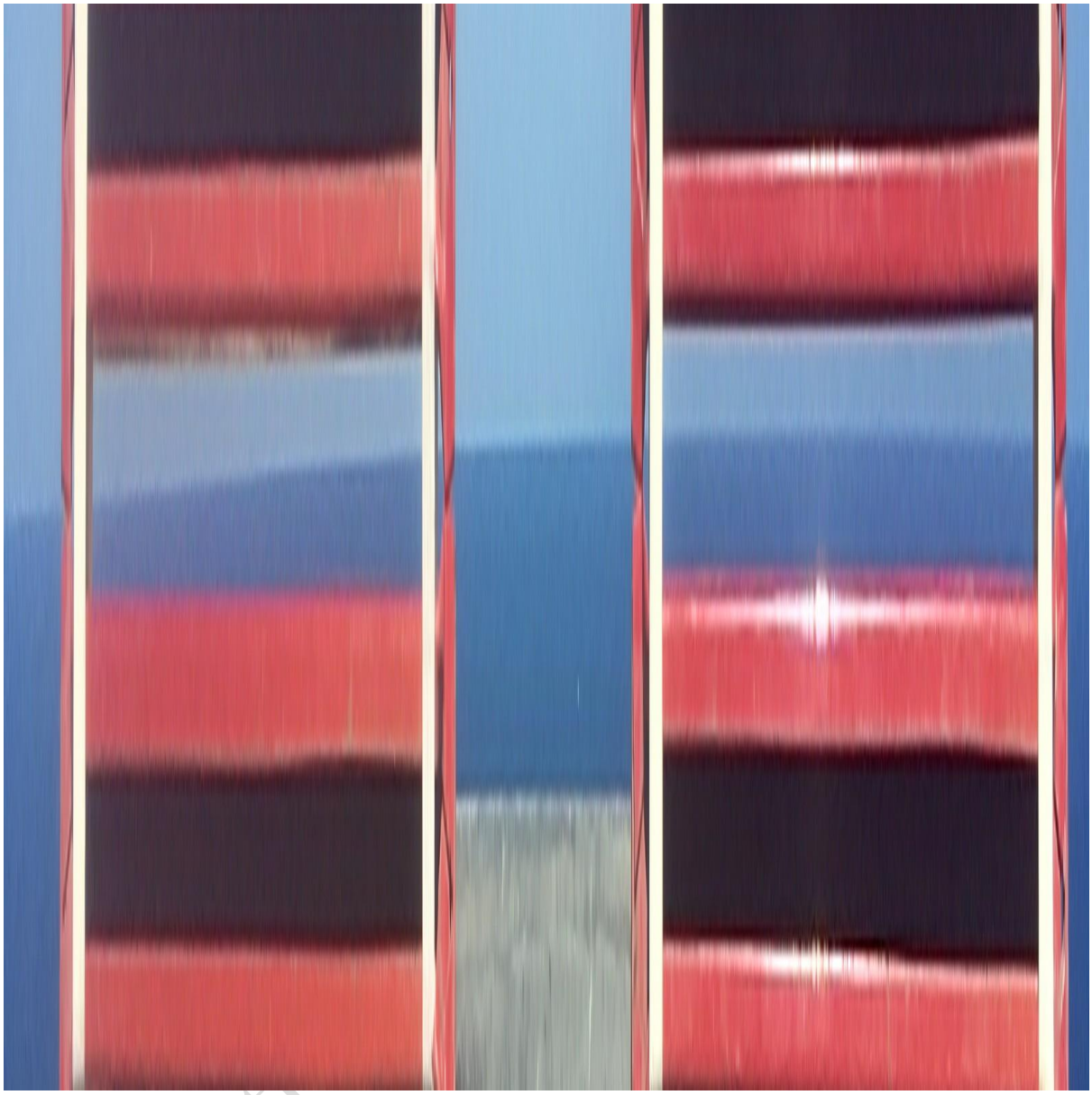
The high resolution photo is available here:

https://mctoon.net/wp-content/uploads/2019/05/31-horizon-o-matic-original.jpg

The curve is slight, but when you zoom in, you can see the distance between the right edge and the horizon change in the image. To do this, you can zoom in and measure the distance between the edge and the horizon and scroll from left to right to compare. Feel free to download the image and examine it. EXIF information has been preserved, including GPS coordinates and the altitude where the photos were taken.

The images were taken on the island of Ibiza at 39°2’30.24" N, 1°18’47.388" E at an altitude of 192 meters. Feel free to download the image and check the EXIF information.

There are some techniques to make the left-to-right curve easier to visualize, other than zooming and panning. For example, if we simply compress the image horizontally, we can see the curve much more easily. This isn't a manipulation technique; it simply allows us to compare the entire enlarged photograph in a single image. Here's the photo with the right edges cropped and compressed horizontally:



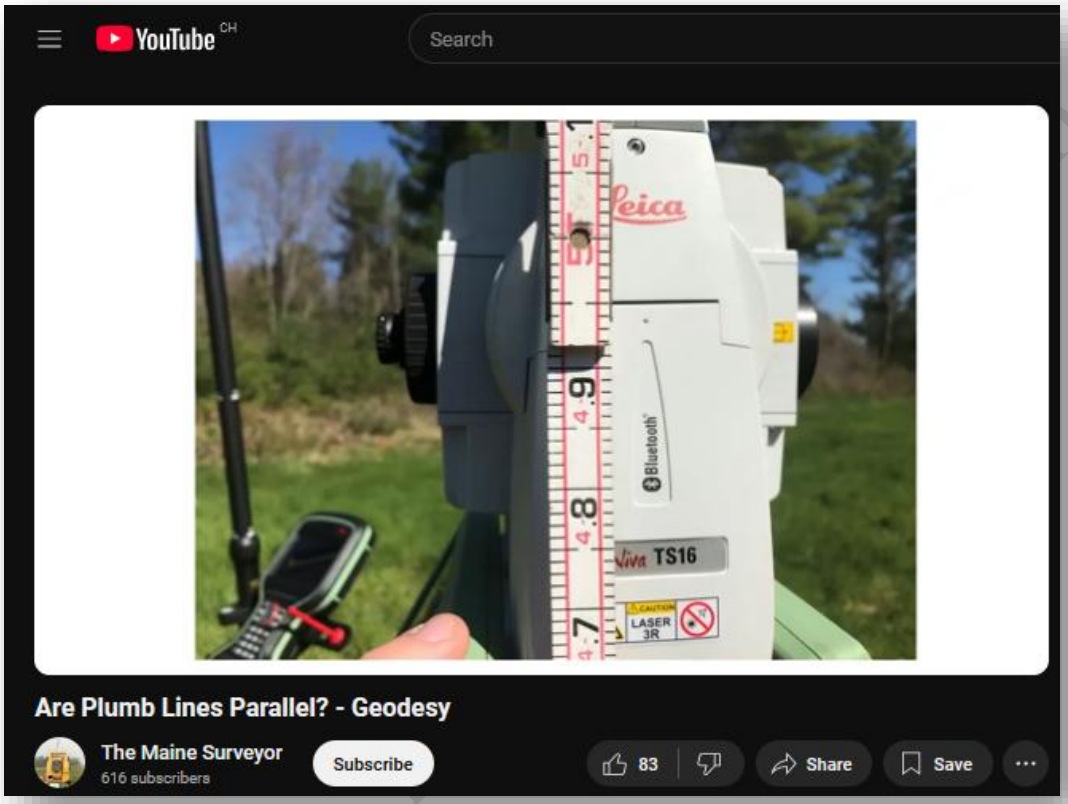
We can see that the right edges are straight and the horizon is curved. Strong evidence of the left-to-right curve and therefore of Earth's curvature.

translati

(#072) Plumb lines proven non-parallel

With basic skills in geomatics and mastery of tacheometers (now named "total stations") we can easily check over short distances that the plumb lines are not parallel as proven by this detailed 32 minutes video recorded experiment:

https://www.youtube.com/watch?v=ec6KeEyxhMo



The material being:

- A Leica TS-16 robotic total station operated in manual mode (theodolite)
- Leica round prism with flat target
- 2 Leica bases
- 2 Sokkia tripods
- 2 rebars, 1.27 cm in diameter, 45.72 cm in length
- 2 rebar caps with center points, embossed "CONTROL POINT"
- Leica GS-16 receiver with CS-20 controller for data collection
- Leica 2 meter pole with bipod

translation

- Lufkin 6-foot folding ruler, graduated in tenths of a foot

The angles were measured several times to take into account fluctuations as usual, giving:

First point of reference (#402)	Second reference point (#404)
90°10'43''	89°49'31''
90°10'52''	89°49'31''
90°10'51''	89°49'30''
90°10'42''	89°49'30''
90°10'53''	89°49'26''
Average: 90°10'48''	Average: 89°49'30''

We then have as standard deviation:

±5'' for the repetitions of #402 to #404
±2'' for the repetitions of #404 to #402

We then have:

	Degrees, arc-seconds	Decimal degrees
Average ZA from #402 to #404	90°10'40''	90.177778°
Average ZA from #404 to #402	+89°49'30''	89.825°

Hence an average deviation from 90° of :

$$\bar{x} = \frac{(90.177778 - 90) + (89.825 - 90)}{2} = 0.001389^\circ$$

And :

Standard Deviations (sigma)	Standard deviations from the mean (standar error)	Standard deviations from the mean (standar error) in degrees
±5'' for the repetitions of #402 to #404	±2'' for the repetitions of #402 to #404	±0.000555556° for the repetitions #402 to #404
±2'' for the repetitions of #404 to #402	±1'' for the repetitions of #404 to #402	±0.000277778° for the repetitions #402 to #404

Reminder: The standard deviation from the mean is how close the mean is to the true mean (for the proof see (Opera Magistris, 2024)).

So the average of the standard deviations from the mean is:

$$\sigma_T = \sqrt{\sigma_1^2 + \sigma_2^2} = \sqrt{0.000555556^2 + 0.000277778^2} = 0.00062113^\circ$$

We apply the NHST of the *Z*-test :

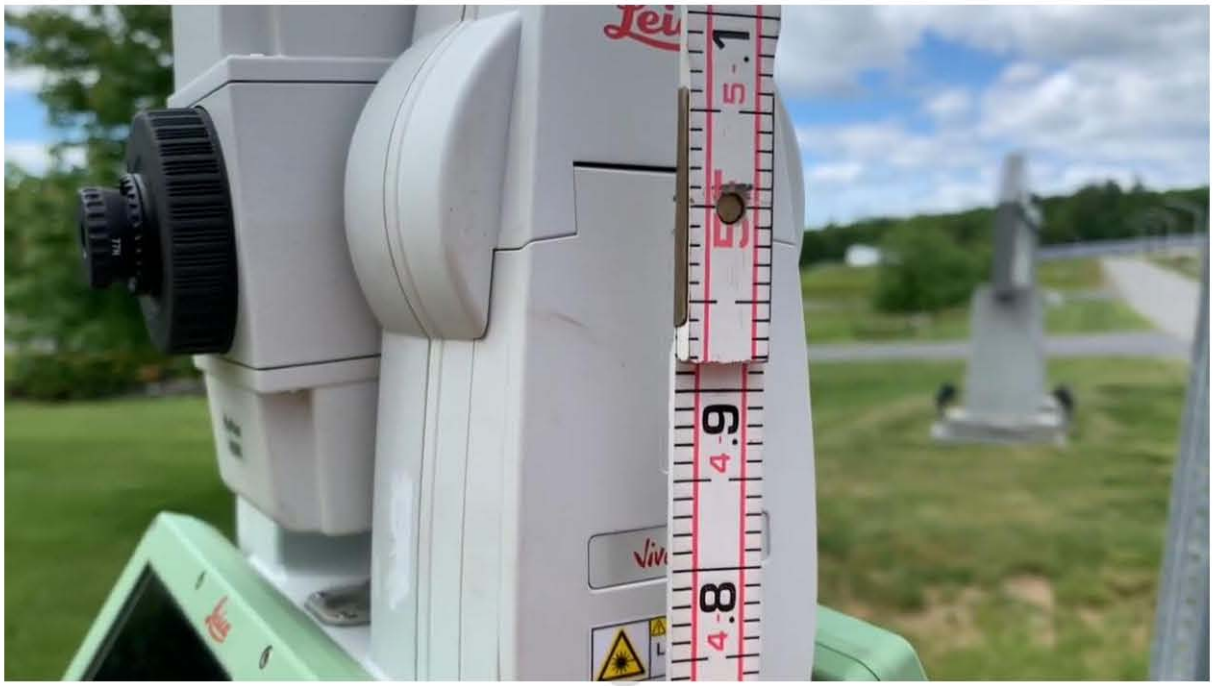
$$Z = \frac{\bar{x} - \mu}{\sigma/n} = \frac{\bar{x} - \mu}{\sigma/n} = \frac{0.001389 - 0}{0.00062113} = 2.236245074$$

translation into english ongoing

So the corresponding *p*-value is 0.0253. It is therefore statistically significant, meaning we have scientifically proven the Earth's curvature using a theodolite!

And this second independent experience in another place:

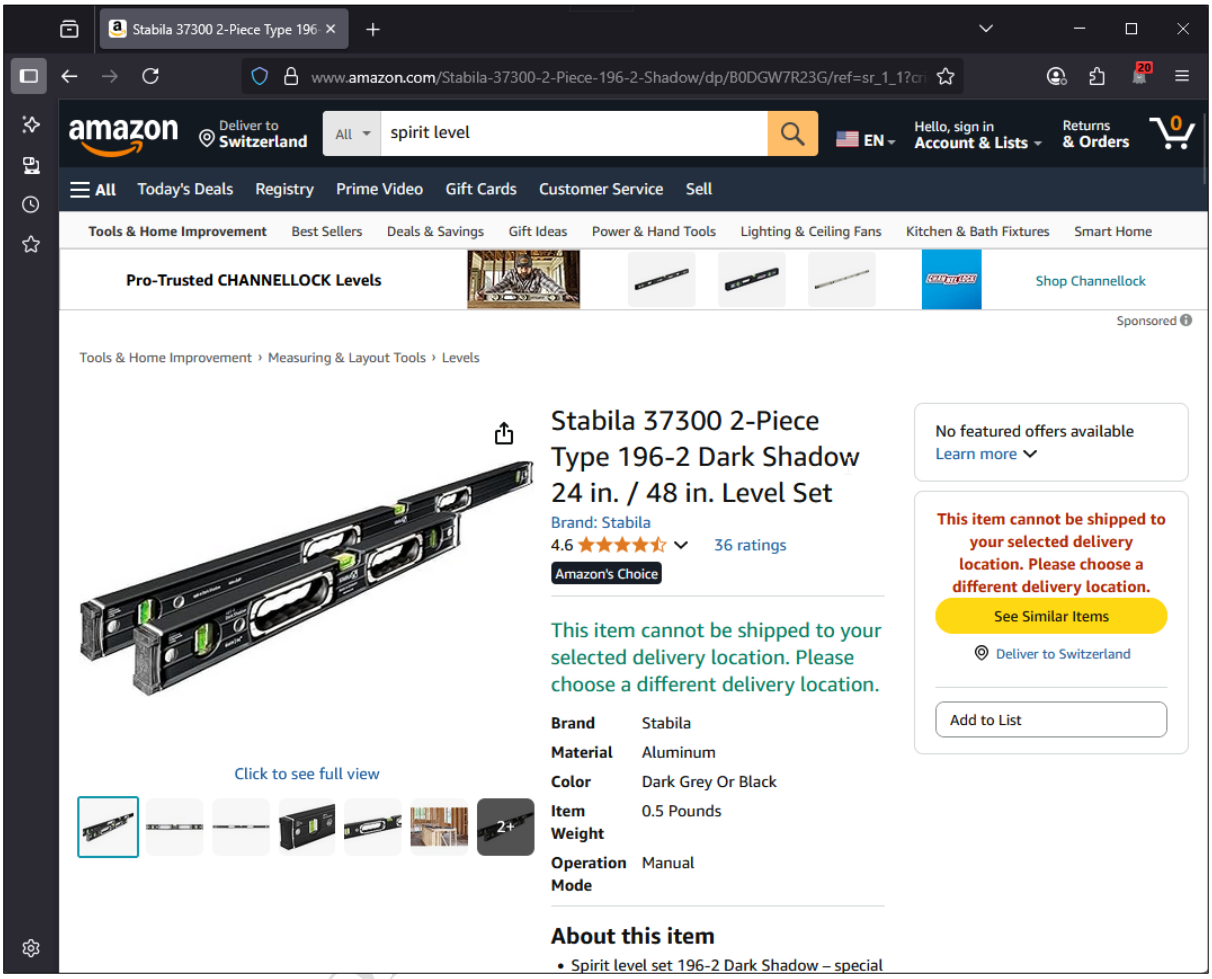
https://www.youtube.com/watch?v=VSJH7d6Cayg



translation into

(#073) Spirit level

With a 122 centimeter spirit level that is affordable for anyone with an income since even larger ones it remains only around 200 USD:



For example, Clouds Givemethewillies conducted his little experiment which he shared on the forum:

https://www.metabunk.org/threads/measuring-the-curvature-of-the-horizon-with-a-level.7832/

at an altitude of 110 meters at coordinates 52°24'31.2"N 4°05'21.9"W in England:

He has photographed his spirit level:

Hence by compressing horizontally and cropping the interesting part:

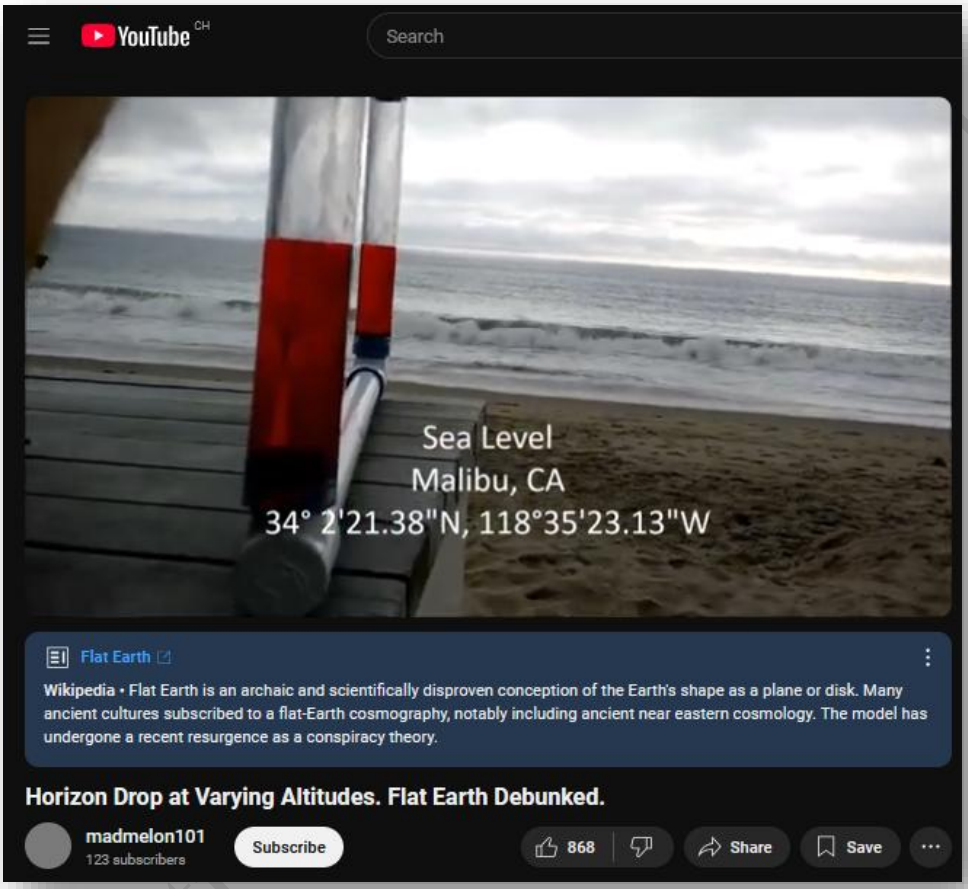
A horizontal line can be superimposed horizontally to help:

So there's no doubt! Even with a simple spirit level, you can demonstrate that the Earth is curved!

(#074) Declination of the horizon

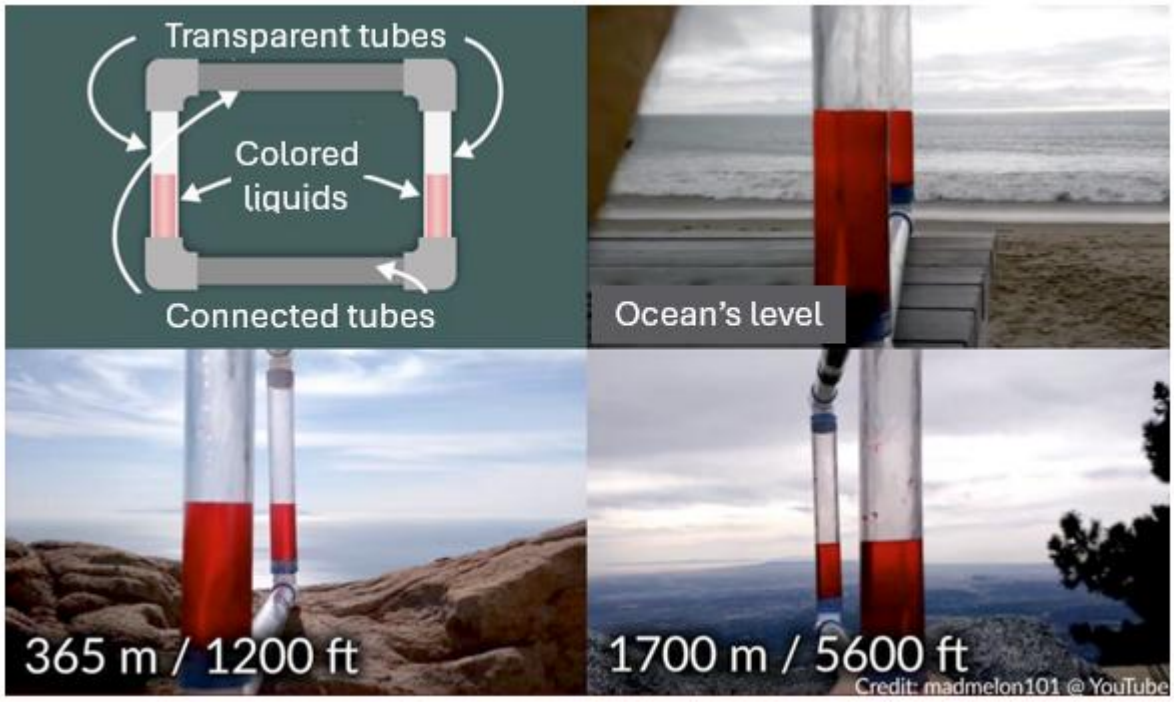
Another empirical experiment that can be easily done at low cost with a U-tube or with a slightly more complicated configuration with a colored or non-viscous liquid is the observation of the declination of the horizon as a function of altitude, which also proves that the Earth is not flat.

https://www.youtube.com/watch?v=NqOQ_BCtqUI


YouTube CH
Search
Sea Level
Malibu, CA
34° 2'21.38"N, 118°35'23.13"W
Flat Earth
Wikipedia • Flat Earth is an archaic and scientifically disproven conception of the Earth's shape as a plane or disk. Many ancient cultures subscribed to a flat-Earth cosmography, notably including ancient near eastern cosmology. The model has undergone a recent resurgence as a conspiracy theory.
Horizon Drop at Varying Altitudes. Flat Earth Debunked.
madmelon101
123 subscribers
Subscribe
868
Share
Save

We have at the following different points:

- Ocean level at Malibu, CA: 34° 2'21.38"N, 118°35'23.13"O
- 365m of altitude at Malibu, CA: 34° 2'55.72"N, 118°37'23.19" O
- 1700m at Mt. Wilson, CA: 34°13'21.52"N, 118° 3'46.07"O



The experience shows that the horizon drops with elevation, as expected with an Earth having curvature. While this experiment does not prove that the Earth is spherical, it does prove that it has positive curvature and that is not flat to the dimensions claimed by flat Earth proponents...!

This is evidence that observations show that the visual horizon (the one at eye level) is not aligned with the Earth's horizon line as it should be on a flat Earth. This supports all other evidence for a curved Earth.

translation into englis

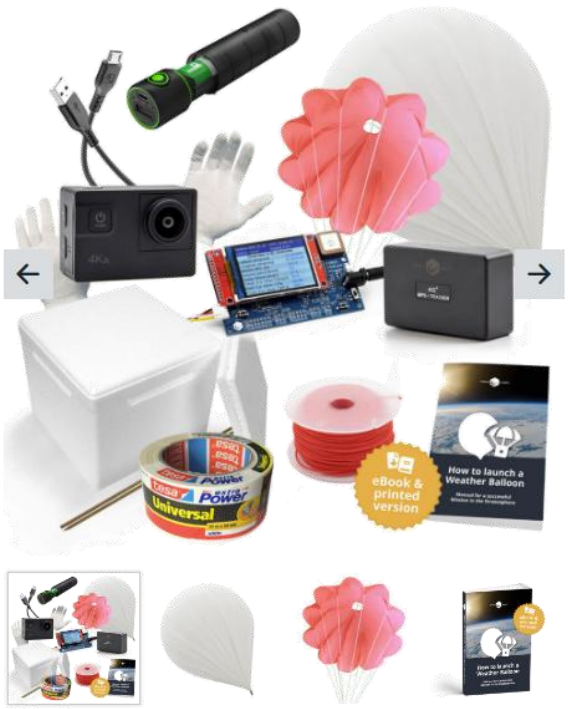
(#075) Weather/Stratospheric balloon

A stratospheric balloon is a type of balloon designed to reach the stratosphere, a layer of Earth's atmosphere located between approximately 10 and 50 kilometers above sea level. These balloons are usually filled with helium or hydrogen, which allows them to rise to great heights.

It is possible to get a relatively complete kit here for around €1,400:

https://www.stratoflights.com/en/shop/weather-balloon-kit/

translation in progress



Weather Balloon Kit

(5 customer reviews)

Item number: 100600

1.387,95 €

incl. 19% VAT plus **shipping costs**

In stock

Delivery time: 3-5 days*

Worldwide shipping

Weather Balloon 3000 / Parachute 2500 (+550,00 €)

no second GPS Tracker

with Datalogger STRATO4, Battery, SD-Card (+308,95 €)

no Space Cam

no STRATOlab Experiment mount

1 Add to cart

Prepayment Billing PayPal SOFORT VISA

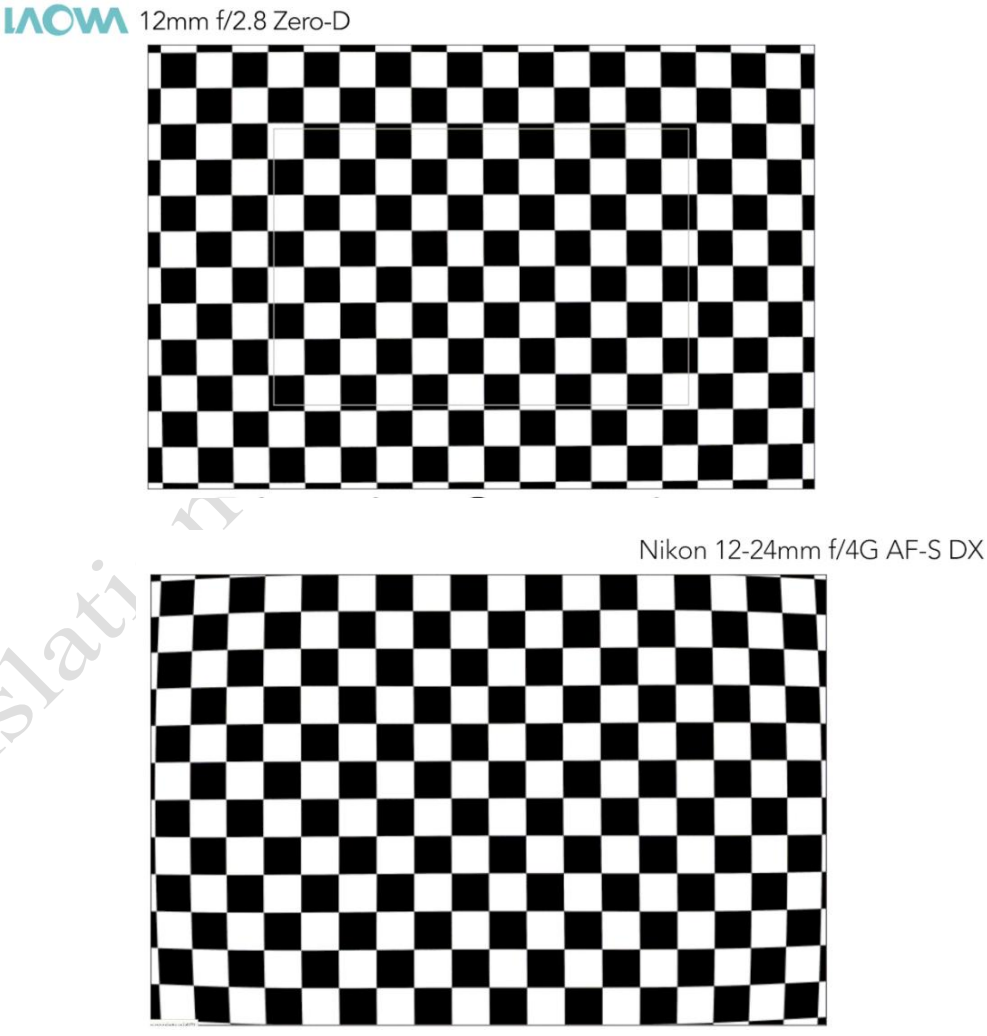
Shipping weight: 3.5kg

Then, it is possible to replace the GoPro which has a fish-eye with a Lumix GH5 which costs between 700 and 1300€ depending on the supplier:

And in order to avoid the fisheye effect, to take the best lens on the market, the Laowa 7.5mm f/2 MTF with a viewing angle of 110 degrees for a price around €400:

translation ongoing

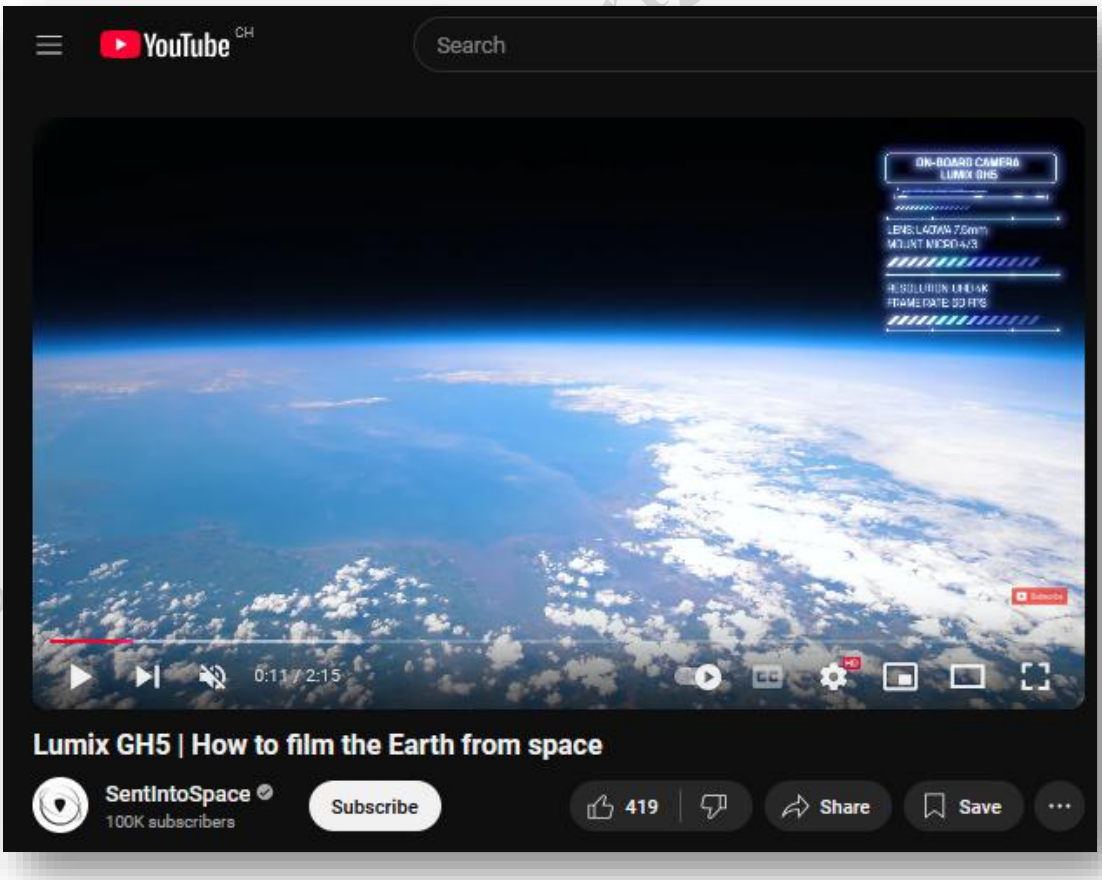
We can compare side by side its low distortion over such a wide angle of view relative to a Nikon 12-24mm f/4G AF-S DX:



We can see from the photo below with this lens its wide viewing angle and its indistinguishable distortion:

And now if this is sent into the stratosphere, it gives by the company https://www.sentintospace.com in Ultra HD 4K 60 FPS:

https://www.youtube.com/watch?v=15mNFaHC4ao



So this is again an empirical, repeatable, measurable, controllable, verifiable, calculable and indebunkable experience that the Earth is a sphere and not flat with a video obtained without a fisheye lens!

translation into english ongoing

(#076) Amateur rocket

On October 1, 2022, Kip Daugirdas (https://www.linkedin.com/in/kip-daugirdas-b5978b21/) successfully conducted an exceptional two-stage flight toward the mesosphere. The rocket, which he named MESOS, measured 3.75 meters in length and weighed approximately 39.5 kg at liftoff. It was powered by an O4500 booster engine coupled to an M830 second-stage engine. The launch took place from the dry lakebed of Black Rock Playa, a vast desert area located in northwestern Nevada, USA.

Figure 51 Kip Daugirdas, Noah Joraanstad and Joe Hepworth hoist MESOS onto the launch tower

Thanks to this powerful configuration, the rocket reached a precise maximum altitude of approximately 89,455 meters, skirting the edge of space. During its ascent, the vehicle experienced a maximum acceleration of 15.6 G and reached a breathtaking speed of Mach 4.18 (approximately 4,440 km/h). The entire flight management, from the ignition of the second stage to the safe deployment of the parachutes, was controlled by Multitronix's Kate-3 tracking and telemetry system (https://www.multitronix.com).

To visually capture this feat, the avionics module carried two GoPro Hero-9 cameras mounted on the side, just below the antennas. To avoid typical image distortions in the corners, their original lenses were replaced with special 4.35mm (16-megapixel), f/2.8 aperture, 60° horizontal FOV, low-distortion M12 rectilinear lenses modified by Back-Bone (https://www.back-bone.ca).

Back-Bone Gear 4.35mm 16MP M12 Mount Lens for Ribcage Modified Cameras

BH #BABBM12435 • MFR #BBM12435 ★★★★☆ 1 review Share Print

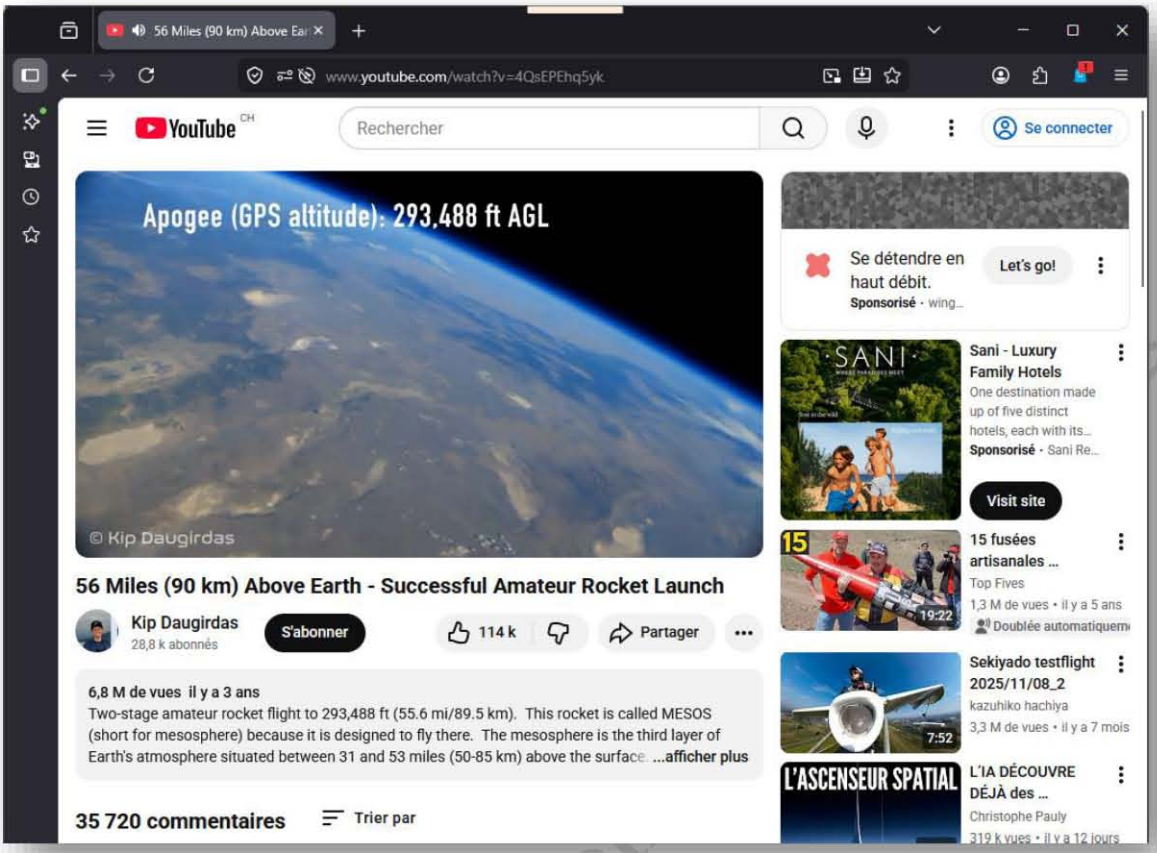
Although one of the cameras suffered from a known overheating issue due to prolonged activation 30 minutes before liftoff, the equipment still managed to capture impressive images of the Earth's curvature before the rocket was safely recovered.

Technical details are available here:

https://www.multitronix.com/293k-flight.html

and the 12-minute time-lapse video:

translation into english pending


56 Miles (90 km) Above Ear
www.youtube.com/watch?v=4QsEPEhq5yk
YouTube CH
Rechercher
Se connecter
Apogee (GPS altitude): 293,488 ft AGL
© Kip Daugirdas
56 Miles (90 km) Above Earth - Successful Amateur Rocket Launch
Kip Daugirdas
28,8 k abonnés
S'abonner
114 k
Partager
6,8 M de vues il y a 3 ans
Two-stage amateur rocket flight to 293,488 ft (55.6 mi/89.5 km). This rocket is called MESOS (short for mesosphere) because it is designed to fly there. The mesosphere is the third layer of Earth's atmosphere situated between 31 and 53 miles (50-85 km) above the surface. ...afficher plus
35 720 commentaires
Trier par
Se détendre en haut débit.
Sponsorisé · wing...
Let's go!
SANI
Sani - Luxury Family Hotels
One destination made up of five distinct hotels, each with its...
Sponsorisé · Sani Re...
Visit site
15
19:22
15 fusées artisanales ...
Top Fives
1,3 M de vues • il y a 5 ans
Doublée automatiquem
7:52
Sekiyado testflight 2025/11/08_2
kazuhiko hachiya
3,3 M de vues • il y a 7 mois
L'ASCENSEUR SPATIAL
L'IA DÉCOUVRE DÉJÀ des ...
Christophe Pauly
319 k vues • il y a 12 jours

translation into e

(#077) Stick (gnomon) and shadow

This is the simplest and most powerful proof on the globe because it only requires a stick near the experimenter, making it impossible to find excuses related to financial means, travel to another country, or any kind of lens or vision dome effect. For 2,500 years, flat-Earthers have been unable to create a predictive mathematical model to explain how a shadow follows its observed trajectory.

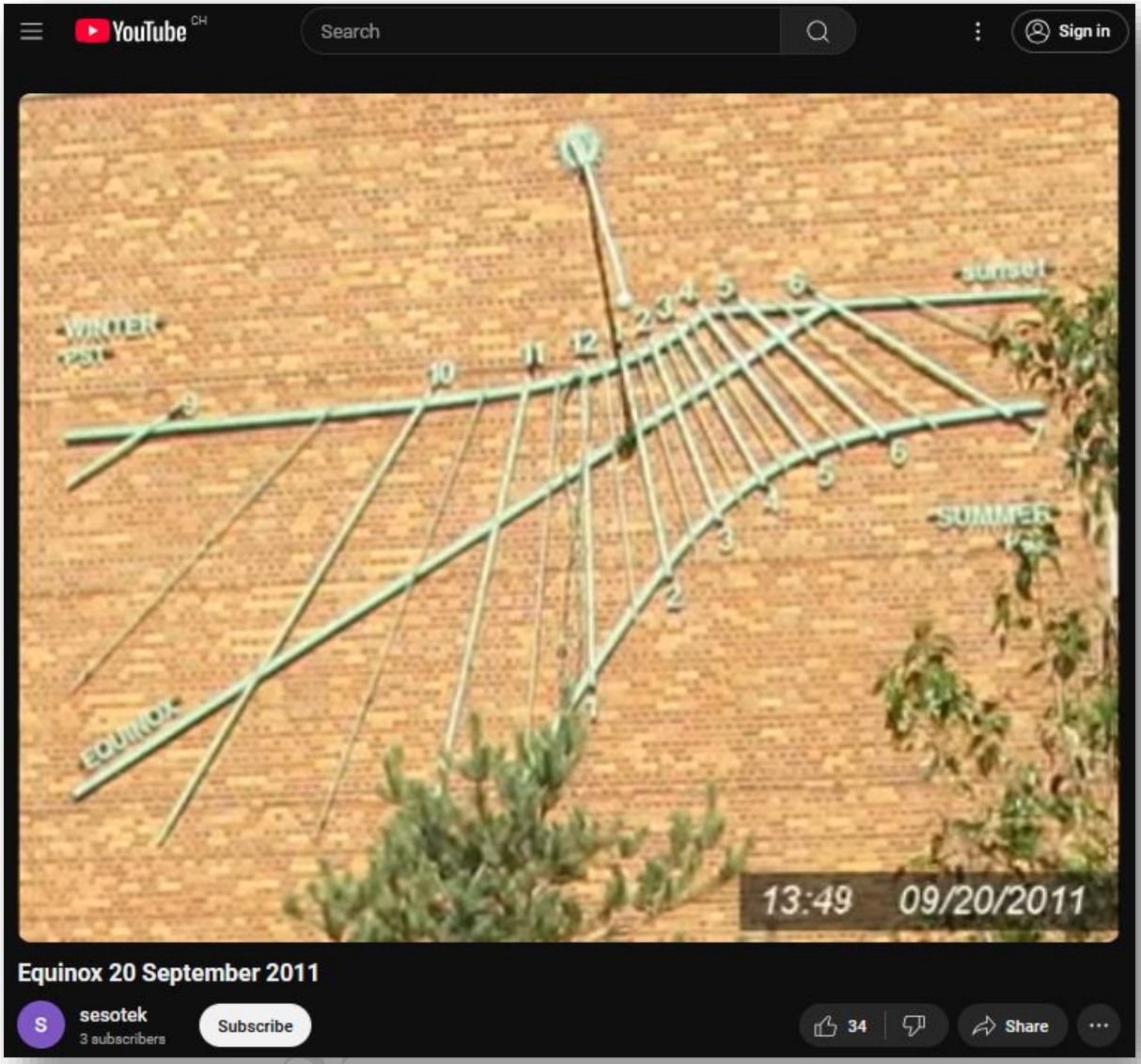
On a flat Earth with the Sun (according to flat-earthers) at a fixed height and rotating in a circle, the shadows of the sticks during a day should all form circles as illustrated below:

Figure 52 Shadow of sticks on a flat Earth (author: Jos Leys)

But bad luck... for our flat-earther friends because in reality the trajectories of the shadow form hyperbolas and even worse... on the day of the equinox the trajectory of the shadow (its end to be exact!) generates a straight line that goes from West to East in the Northern hemisphere which is impossible on a flat Earth! If necessary here is a timelapse video of the shadow of a solar clock which is indeed horizontal on the day of the equinox:

https://www.youtube.com/watch?v=-eEeteYRlBg

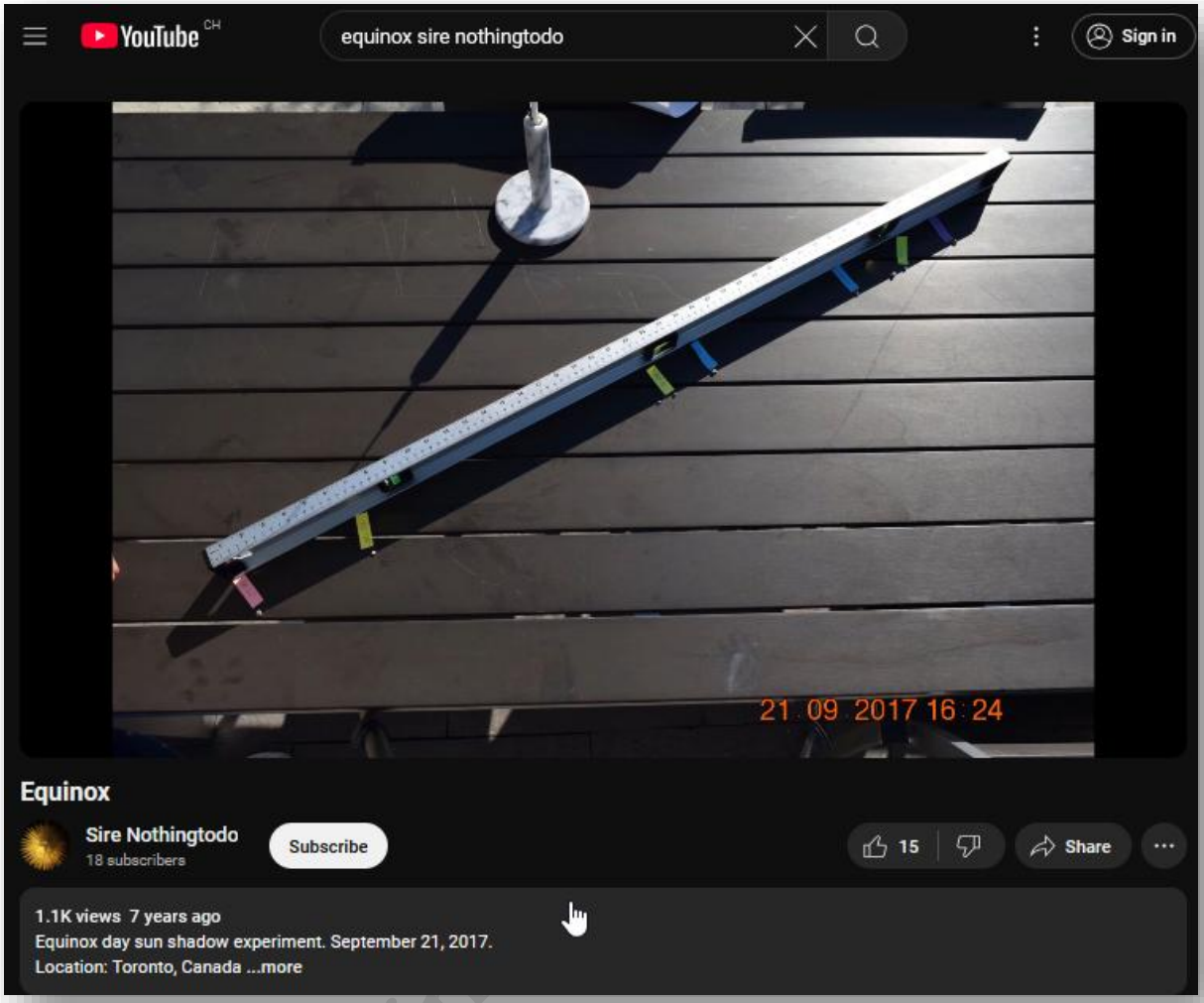
translation



Or the following video for those who prefer a truly vertical stick on the ground rather than a solar clock:

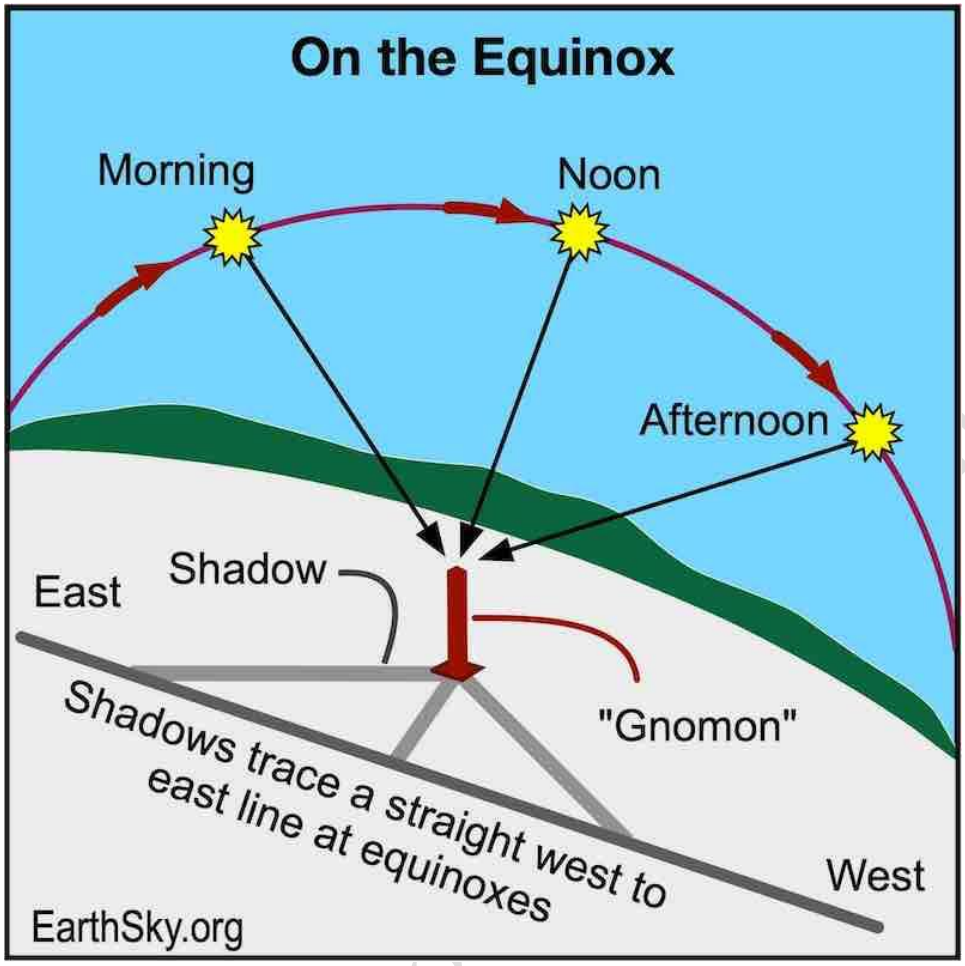
https://www.youtube.com/watch?v=QNmH_UKM8fg

translation



To better understand, here is a diagram that may help (reproduced with permission from EarthSky.org):

translation in

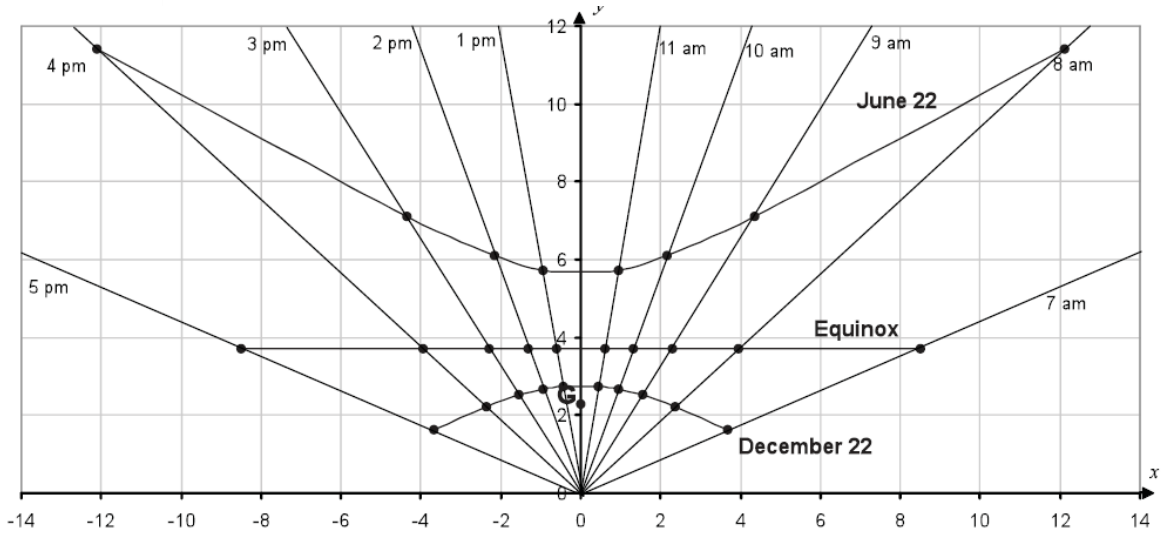


As proved by Jill Vincent (University of Melbourne) in his 11 pages paper *The mathematics of sundials* (for a more detailed derivation see (Opera Magistris, 2024)), the shadow of the gnomon can only be correctly described on a sphere and the final result of the proof is:

$$\left(\frac{h\sin(T)}{\cos(T)\cos(L)-\tan(D)\sin(L)}, \frac{h\cos(T)}{\sin(L)[\cos(T)\cos(L)-\tan(D)\sin(L)]}\right)$$

For the horizontal sundial "Solaris" at the Piazza Italia in the inner Melbourne suburb of Carlton, we have for latitude $L = 37.8°$ and for the equinoxes and the Summer and Winter solstice (respectively $D = 0°, 23.5°$ et $-23.5°$) for a Gnomon of height $h = 1.8$ m, we have:

translation in progress



Which can be obtained with the following Python code:

Qui peut être obtenu avec le code Python suivant :

```
import numpy as np
import matplotlib.pyplot as plt

# Geographical and geometrical parameters
L = np.radians(37.8)  # Latitude (converted to radians)
h = 1.80              # Height of the stick in meters
Gx, Gy = 0, 0         # Position of the stick centered at G = (0, 0)
D_vals = [0, 23.5, -23.5]  # Declinations (Equinox, June 22,
December 22)
D_labels = ["Equinox", "June 22", "December 22"]  # Labels for each
declination
colors = ["gray", "lightgray", "black"]  # Colors for the curves

# Time from 7 AM to 5 PM (hours)
hours = np.arange(7, 18)
T = np.radians(15 * (12 - hours))  # Hour angle in radians (15
degrees per hour)

# Create the figure for plotting
plt.figure(figsize=(14, 6))
ax = plt.gca()  # Get the current axes object

# Dictionary to store coordinates for each shadow curve
all_coords = {}

# Loop through each declination to plot the shadow curves
for D_deg, label, color in zip(D_vals, D_labels, colors):
    D = np.radians(D_deg)  # Convert declination to radians
    x_vals, y_vals = [], []  # Lists to store x and y coordinates of
the shadow tips

    # Loop over all hour angles (T) to calculate the shadow
positions
```

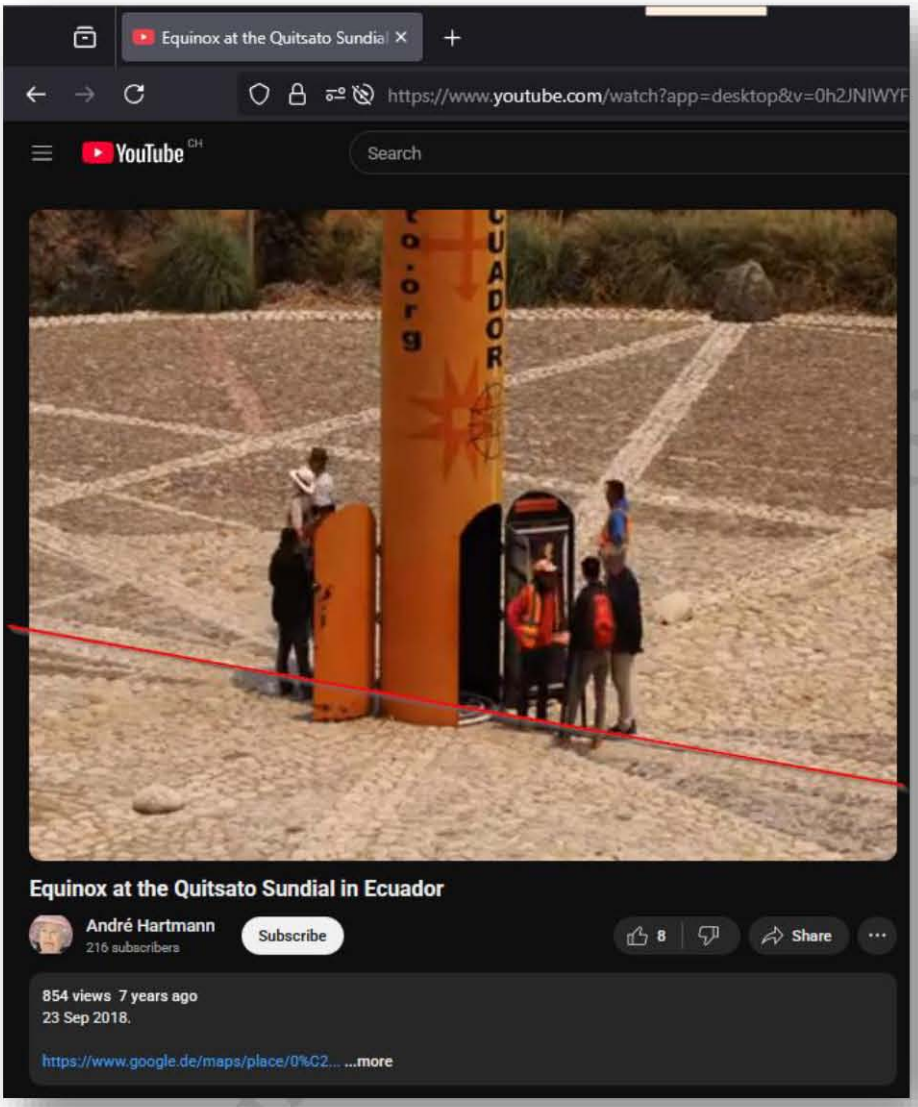
```
    for t in T:
        denominator = np.cos(t) * np.cos(L) - np.tan(D) * np.sin(L)
        x = h * np.sin(t) / denominator  # X coordinate of the
shadow tip
        y = h * np.cos(t) / (np.sin(L) * denominator)  # Y
coordinate of the shadow tip

        # Append the coordinates to the lists
        x_vals.append(Gx + x)
        y_vals.append(Gy + y)

    # Limit the curve for June 22nd between 8 AM and 4 PM
    if label == "June 22":
        idx_range = (hours >= 8) & (hours <= 16)  # Select hours
between 8 AM and 4 PM
        x_plot = np.array(x_vals)[idx_range]
        y_plot = np.array(y_vals)[idx_range]
        all_coords[label] = (x_vals, y_vals)  # Store the
coordinates
    else:
        x_plot = x_vals  # Use all values for the other dates
        y_plot = y_vals
        all_coords[label] = (x_vals, y_vals)

    # Plot the shadow curve for this declination
    plt.plot(x_plot, y_plot, label=label, lw=2.5, color=color)

# Find the indices of 5 PM and 7 AM on the Equinox curve
idx_5pm = hours.tolist().index(17)  # Index of 5 PM
idx_7am = hours.tolist().index(7)   # Index of 7 AM

# Plot hour lines and intersections with the shadow curves
for i in range(len(T)):
    # Check if we are at 5 PM or 7 AM
    if i == idx_5pm or i == idx_7am:
        # Extend the line until it intersects the Equinox curve
        x_max = all_coords["Equinox"][0][i]
        y_max = all_coords["Equinox"][1][i]
        # Extend the line by a factor of 1.5
        dx = x_max - Gx
        dy = y_max - Gy
        norm = np.sqrt(dx**2 + dy**2)  # Normalize the vector to
extend the line
        x_max = Gx + 15 * dx / norm  # Scale the x component
        y_max = Gy + 15 * dy / norm  # Scale the y component
    else:
        # Extend the hour lines to intersect with the June 22nd
curve
        x_max = all_coords["June 22"][0][i]
        y_max = all_coords["June 22"][1][i]

    # Plot the line from the stick (G) to the shadow tip
    plt.plot([Gx, x_max], [Gy, y_max], color='black', lw=0.5)
```

```
    # Add a point at each intersection for each declination curve
    for label in D_labels:
        if i < len(all_coords[label][0]):  # Safety check for June
22
            x_i = all_coords[label][0][i]
            y_i = all_coords[label][1][i]
            plt.plot(x_i, y_i, 'ko', markersize=3)  # Plot the
intersection point

    # Label the hours along the Equinox curve
    dx = all_coords["Equinox"][0][i] - Gx  # Difference in x between
G and the shadow tip
    dy = all_coords["Equinox"][1][i] - Gy  # Difference in y between
G and the shadow tip
    norm = np.sqrt(dx**2 + dy**2)  # Normalize the vector
    hour = hours[i]
    label_hr = f"{hour} am" if hour < 12 else ("12 pm" if hour == 12
else f"{hour - 12} pm")  # Hour label
    label_x = all_coords["Equinox"][0][i] + 0.4 * dx / norm  #
Position label along the curve
    label_y = all_coords["Equinox"][1][i] + 0.4 * dy / norm  #
Position label along the curve
    plt.text(label_x, label_y, label_hr, fontsize=8, ha='center')  #
Plot the hour label

# Plot the position of the stick (G)
plt.plot(Gx, Gy, 'ko')  # Mark the position of G with a black dot
plt.text(Gx + 0.2, Gy, 'G', fontsize=9)  # Label the position of G

# Final plot settings
plt.xlabel('x')
plt.ylabel('y')
plt.title('Shadow tip positions (L = 37.8Â°)')
plt.legend()  # Show the legend
plt.grid(True)  # Enable grid
ax.set_aspect('equal')  # Set equal scaling on both axes
plt.xlim(-13, 13)  # Set x-axis limits
plt.ylim(-1, 12)   # Set y-axis limits
plt.tight_layout()  # Adjust layout to avoid clipping
plt.show()  # Show the plot
```

And to conclude, we can look at a timelapse at this address:

https://www.youtube.com/watch?app=desktop&v=0h2JNIWYFpQ

of the sundial (giant gnomon) of Quitsato in Ecuador (and placed right at the equator by the tourist office) on the day of the equinox where we can see – but you have to look carefully because the contrast on the video is low (!) – the shadow of the vertical cylinder which perfectly follows the straight line on the ground of the equator (we have highlighted it in red on the screenshot below), which the supporters of the flat Earth are unable to explain or modelize mathematically:



translation pending

Visibility of curvature from aircrafts

Anyone who has flown on a commercial plane during the day and in good weather conditions can take a picture of the horizon. Because of the poor resolution of the human eye, it is difficult or even impossible (for those who are nearsighted) to see the curvature ..

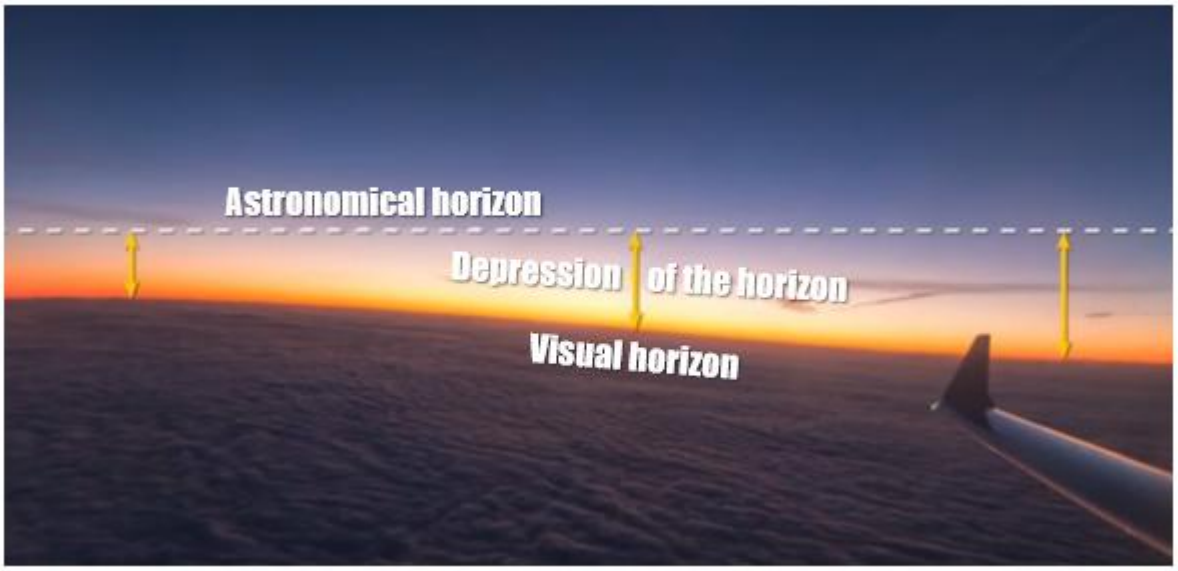
The calculation of the visible curvature in degrees is given by (Opera Magistris, 2024):

$$\alpha \cong \frac{\Delta H}{d_{\text{straight line}}} = \frac{R - \sqrt{R - 2Rh}}{\sqrt{h^2 + 2Rh}}$$

We have for different values of *h* for the radius of the Earth:

Altitude h	Angle α in degrees
1 [m]	0.0160
10 [m]	0.0507
100 [m]	0.160
1,000 [m]	0.507
10,000 [m]	1.605
30,000 [m]	2.783
100 [km]	5.0963
1,000 [km]	16.907
3,000 [km]	40.299

But by distorting the photo taken, you will easily be able to highlight the latter.



Let us also point out in that the windows of commercial aircraft preserve straight lines very well, as anyone can check before takeoff:

English ongoing

Now let’s look at some concrete examples!

translation into engl going

(#078) Flight Dubaï-Bengalurur Boeing 777 300ER (A6-EGO) (~10,000 meters)

From the window of the Boeing 770 300ER we have:

Figure 53 Wing view of an Emirates Boeing 777-300ER, registration A6-EGO. Sunrise seen on flight 564 from Dubai DXB to Bengaluru BLR on July 5, 2015 (source: Wikipedia)

Which when stretched vertically in photo processing software gives:

translation in ...

The curvature of the Earth is clearly visible!

translation into en

(#079) Flight Lufthansa Airbus A321-231 (~11,000 meters)

Or another one :

Figure 54 Lufthansa Airbus A321-231 on February 15 - September 17, 1999 (author: Jonathan Palombo, source: D-AISB)

Which when stretched vertically in a photo processing software gives:

The curvature of the Earth is therefore clearly visible.

(#080) Flight Frankfurt -Amsterdam (~10,000 meters)

Or again another one :

Figure 55 Flight from Frankfurt am Main (FRA) to Schiphol Amsterdam (AMS) on January 10, 2012 at 5:01 PM (51° 04' 45.73" N, 7° 02' 17.22" E) (author: Edgar Jiménez from Porto, Portugal, source: Flickr)

Which when stretched vertically in a photo processing software gives:

The curvature of the Earth is therefore clearly visible.

(#081) Flight D.S.S (Gulfstream G-IV/N57HJ) above the Red Sea (~12,000 meters)

Or again (we'll stop there because it's endless…) at around 12,000 meters:

Figure 56 U.S. Department of State, Secretary John Kerry's view from the plane as he flies over the Red Sea in May 24, 2013 (source: Flickr)

Which when stretched vertically in a photo processing software gives:

(#082) Concorde Flight (~15,000 meters)

The photo below of Concorde in supersonic flight at about 15 kilometers altitude (where we see that the Concorde is not in the center of the photo and is not curved, so it is not a fisheye lens!):

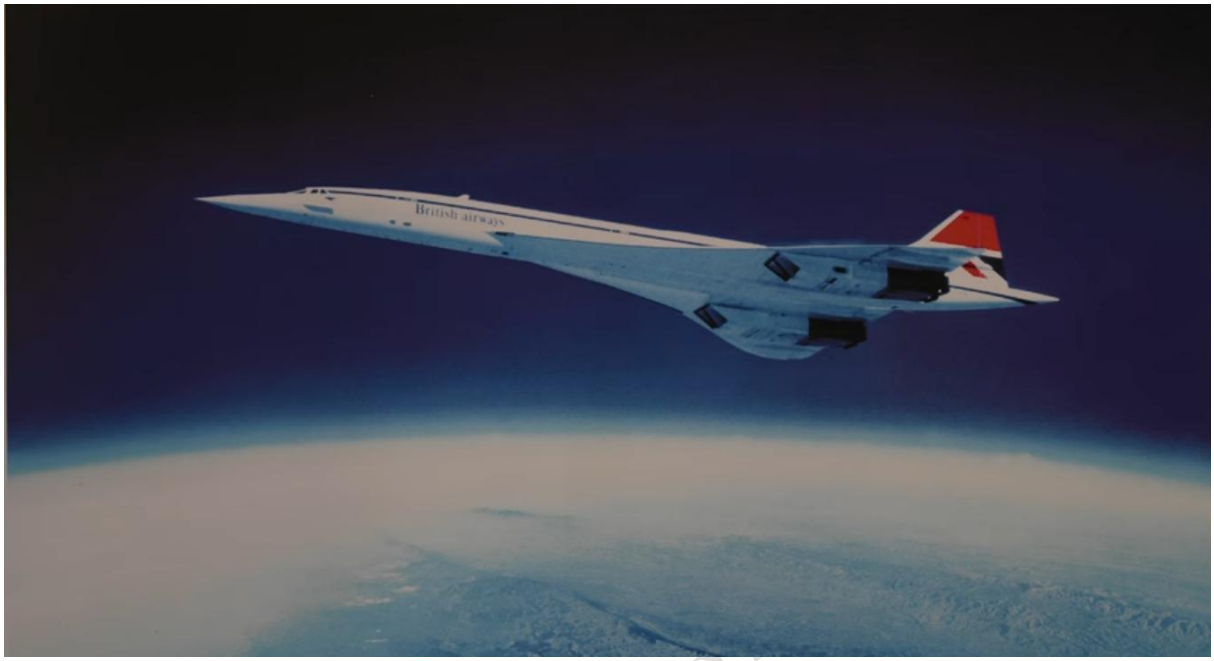
Clearly shows that the curvature of the Earth is visible at high altitudes.

Taken in April 1985 by Adrian Meredith (using a Hasselbad medium format camera, 80mm lens), the above photo is the only photograph of Concorde flying at supersonic speed. The image was taken by Adrian Meredith, who was piloting a Royal Air Force (RAF) ZD 902 F2 Tornado jet during a rendezvous with Concorde over the Irish Sea in April 1985.

Although the Tornado could match Concorde's cruising speed, it could only do so for a few minutes due to the enormous fuel consumption rate.

Several attempts were made to take the photo, and finally Concorde had to slow down from Mach 2 to Mach 1.5-1.6 so that the Tornado crew could take the photo. The Tornado was stripped of everything to allow it to maintain this speed for as long as possible. After racing to catch up with Concorde and struggling to keep up, the Tornado broke off the rendezvous after just four minutes, while Concorde sailed serenely to JFK!

From the same photographer we also have the following photo of the Concorde which clearly shows the curvature of the Earth and keep in mind that the Hasselbad camera does not have a fisheye lens:



We recommend that you purchase this photographer's magnificent book dedicated to to the Concorde:

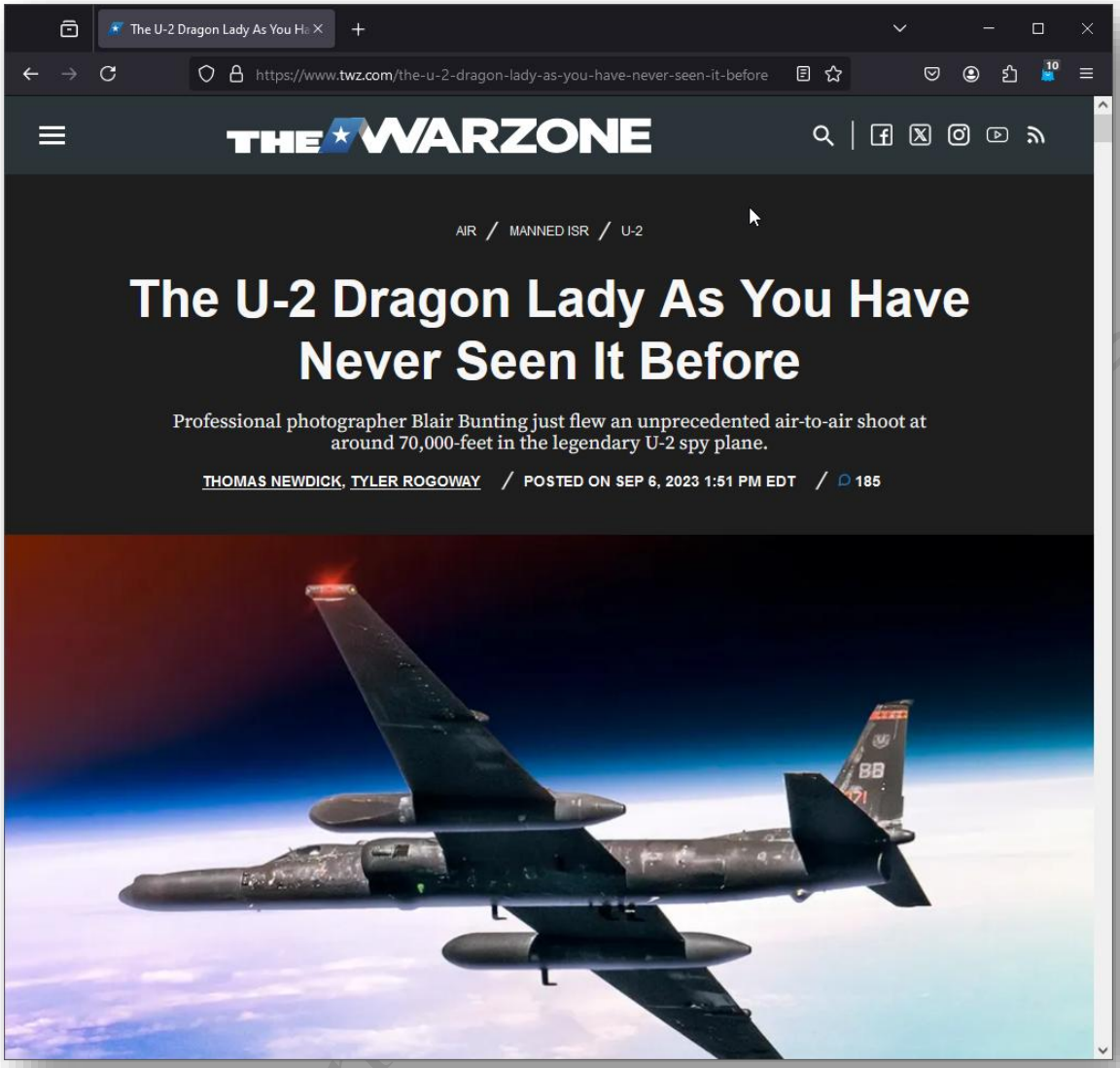
(#083) Vol U2 (~21,000 meters)

Here is a photo from a USAF U2 spy plane at an altitude of 21 kilometers where we can clearly see the curvature of the Earth (as we can see it by observing the wing of the U2T the photo was taken without a fisheye and the cockpit obviously has no distortion effect like in the majority of military aircraft):

Figure 57 The U2 Dragon Lady

The source is here:

https://www.twz.com/the-u-2-dragon-lady-as-you-have-never-seen-it-before


The U-2 Dragon Lady As You Ha
https://www.twz.com/the-u-2-dragon-lady-as-you-have-never-seen-it-before
THE WARZONE
AIR / MANNED ISR / U-2
The U-2 Dragon Lady As You Have Never Seen It Before
Professional photographer Blair Bunting just flew an unprecedented air-to-air shoot at around 70,000-feet in the legendary U-2 spy plane.
THOMAS NEWDICK, TYLER ROGOWAY / POSTED ON SEP 6, 2023 1:51 PM EDT / 185

A video is available here:

https://www.bilibili.com/video/BV1Rs411a7GZ/

translation

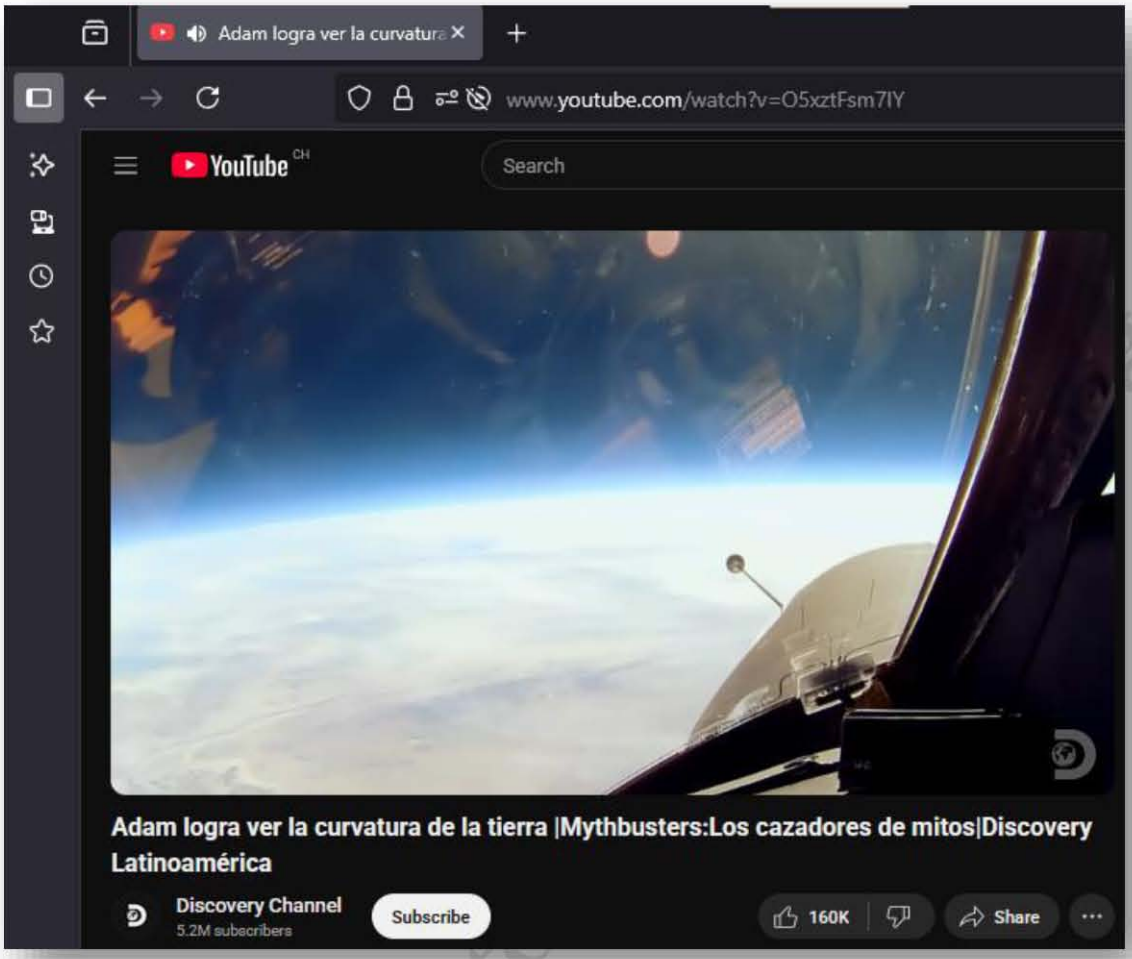
And another video is here:

https://www.youtube.com/watch?v=SxkA82wORtw

And yet another video:

https://www.youtube.com/watch?v=O5xztFsm7IY

translation into



translation int

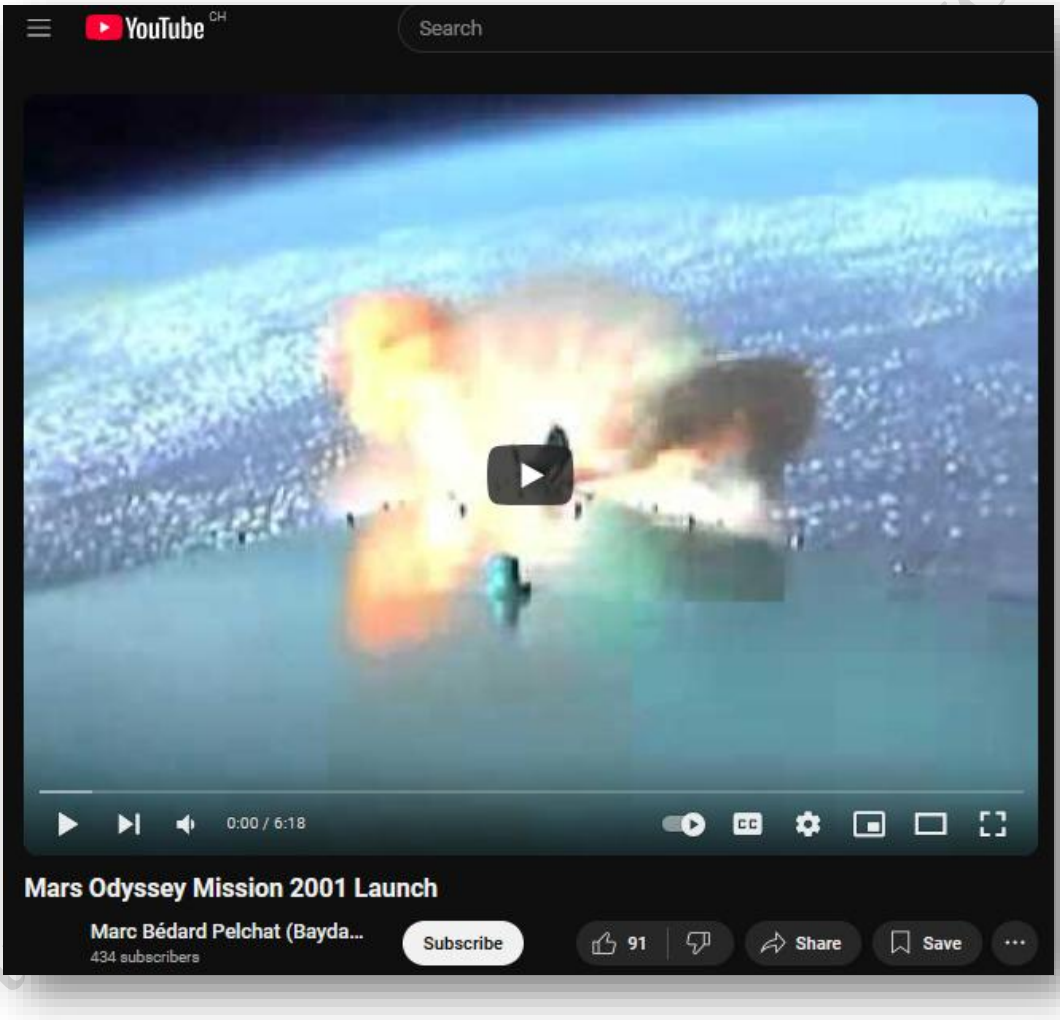
(#084) Visibility of curvature from rockets

There are hundreds of uninterrupted videos from rocket launch to orbit that demonstrate not only that the Earth is curved but also that there is no dome (and which incidentally confirm the gravity model and Newton's laws).

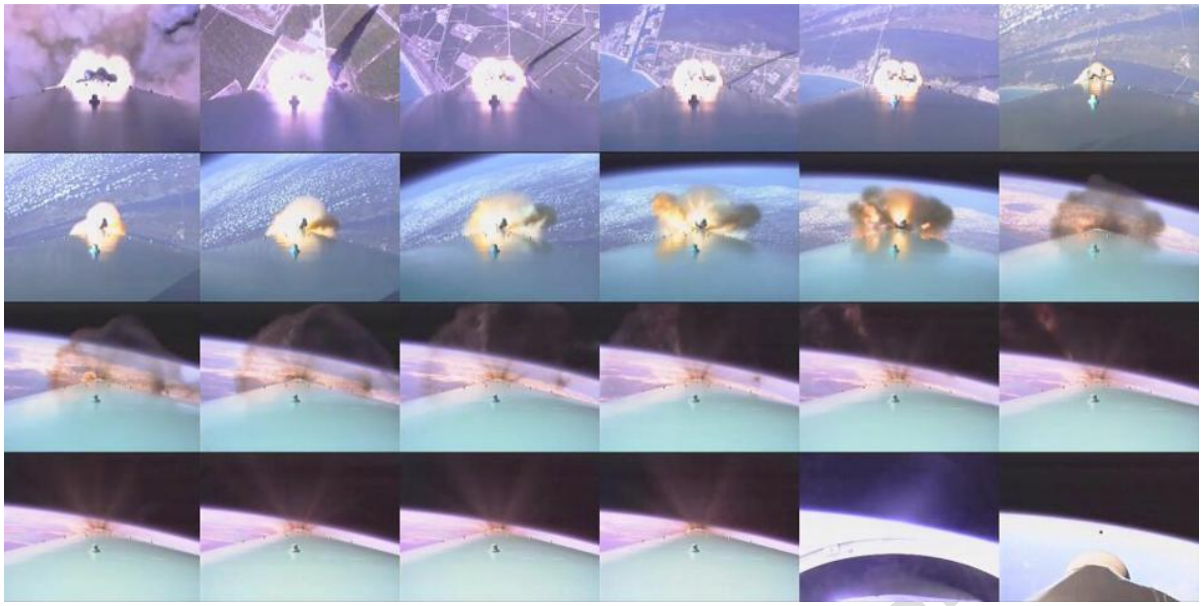
We are not going to list and illustrate them all here because there would be hundreds of pages dedicated to this only topic.

Let's describe the most famous one available here in video (because it would be the first where a camera recorded non-stop) of the Odyssey launch in 2001:

https ://www.youtube.com/watch ?v=KEC6OLHQkII



Or as a mosaic of images:



Odyssey was launched on April 7, 2001, aboard a Delta II rocket from Cape Canaveral Air Force Station (USA) and reached Mars orbit on October 24, 2001, at 2:30 UTC (October 23, 7:30 PM PDT, 10:30 PM EDT).

Once again... the die is cast!

translation into english o

Observations of the angle of depression

As we have already mentioned it, the existence of the depression angle and the corresponding values measured empirically in the field are perfectly consistent with what we can expect on a spherical Earth. .

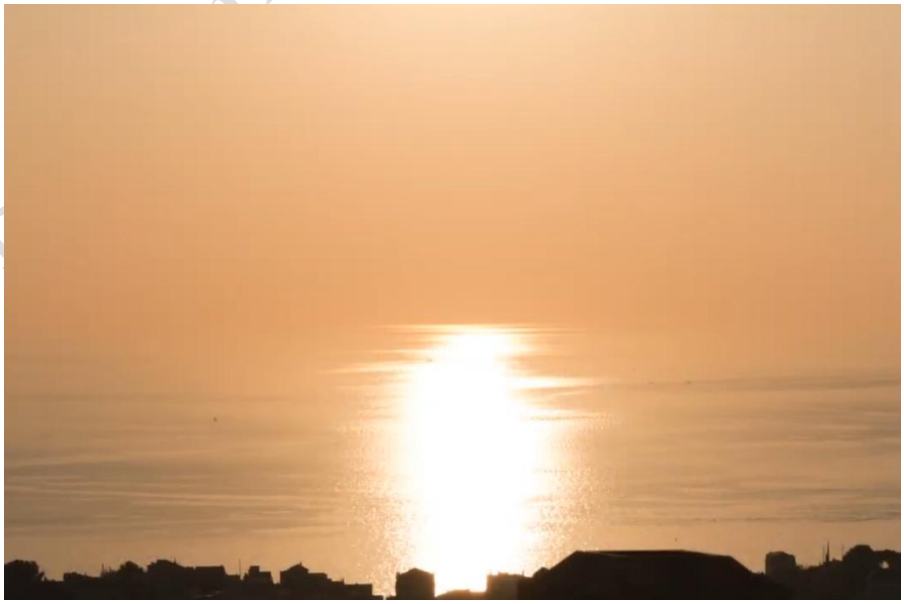
So let's look below at two relatively simple examples that anyone can set up to verify that the Earth is not flat!

(#084) Angle of depression from the ground

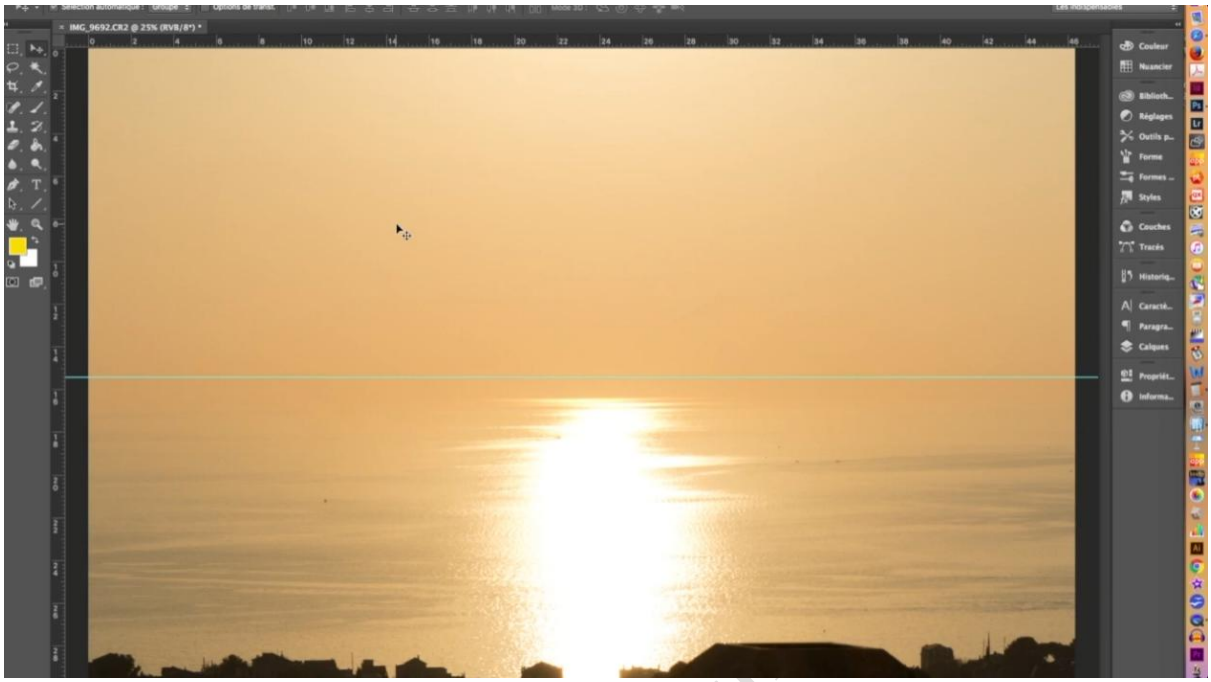
Consider the following setup from Olivier Joseph (Canon EOS 70D, 70-33mm lens):

https://www.youtube.com/watch?v=CslplWmPAng

Let’s take a picture of the horizon from the heights of Marseille (Notre-Dame de la Garde):



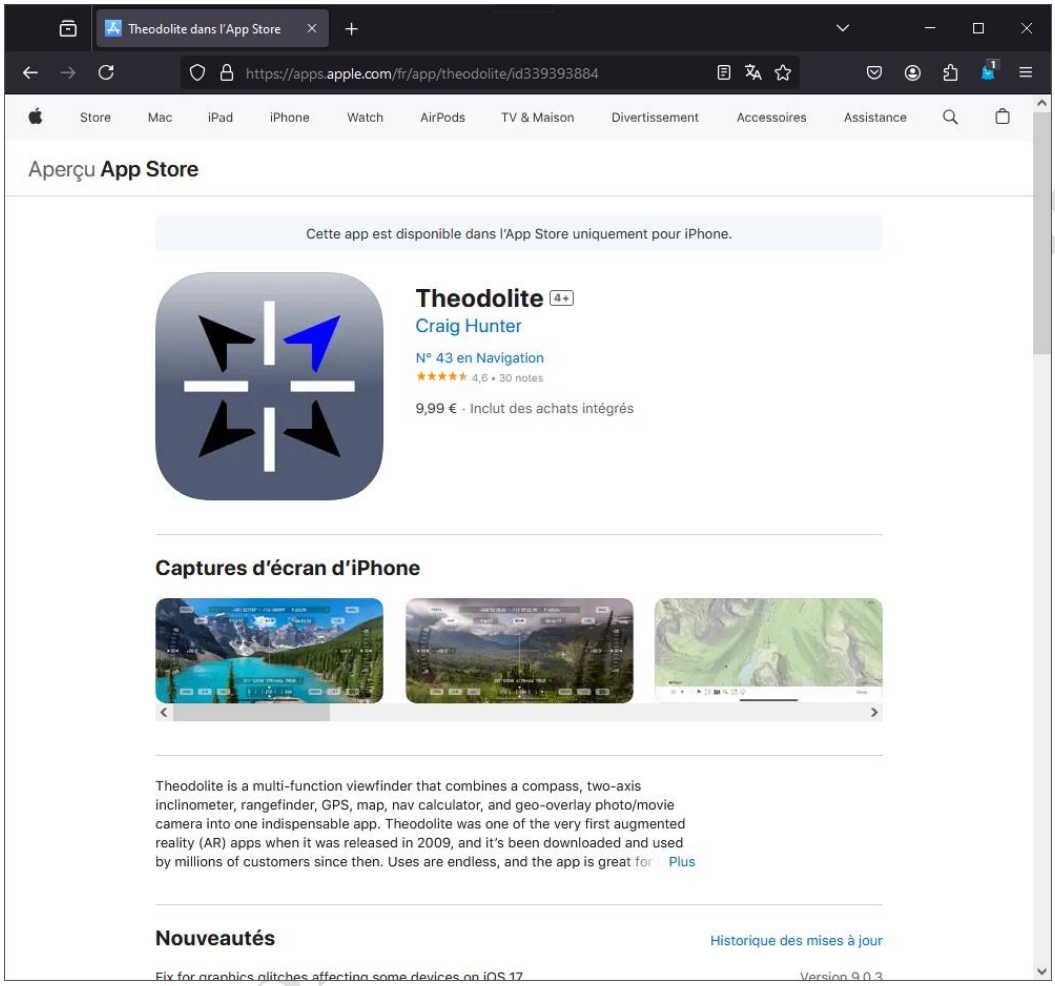
In Adobe Photoshop (or other), we then put a horizontal in the vertical half of the image which corresponds to the astronomical horizon:



Obviously it follows that the difference between the Earth line and the astronomical horizon is due to the curvature of the Earth (!):

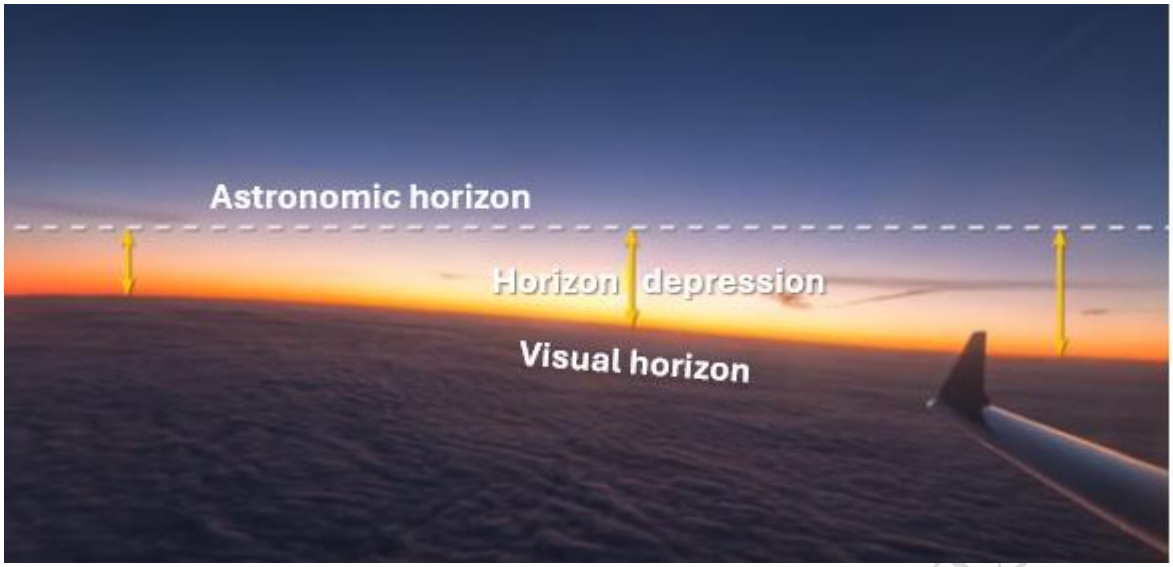
(#085) Angle of depression from an airliner

From the simple *Thedoloite* app available for iPhone (which has an error margin of 0.09 degrees) and costs only €9.99:


Theodolite dans l'App Store
https://apps.apple.com/fr/app/theodolite/id339393884
Store
Mac
iPad
iPhone
Watch
AirPods
TV & Maison
Divertissement
Accessoires
Assistance
Aperçu App Store
Cette app est disponible dans l'App Store uniquement pour iPhone.
Theodolite 4+
Craig Hunter
N° 43 en Navigation
4,6 • 30 notes
9,99 € · Inclut des achats intégrés
Captures d'écran d'iPhone
Theodolite is a multi-function viewfinder that combines a compass, two-axis inclinometer, rangefinder, GPS, map, nav calculator, and geo-overlay photo/movie camera into one indispensable app. Theodolite was one of the very first augmented reality (AR) apps when it was released in 2009, and it's been downloaded and used by millions of customers since then. Uses are endless, and the app is great for
Plus
Nouveautés
Historique des mises à jour
Fix for graphics glitches affecting some devices on iOS 17
Version 9.0.3

It is very easy to see an angle of depression from the portholes, which proves at little cost that the Earth is not flat:

translatio

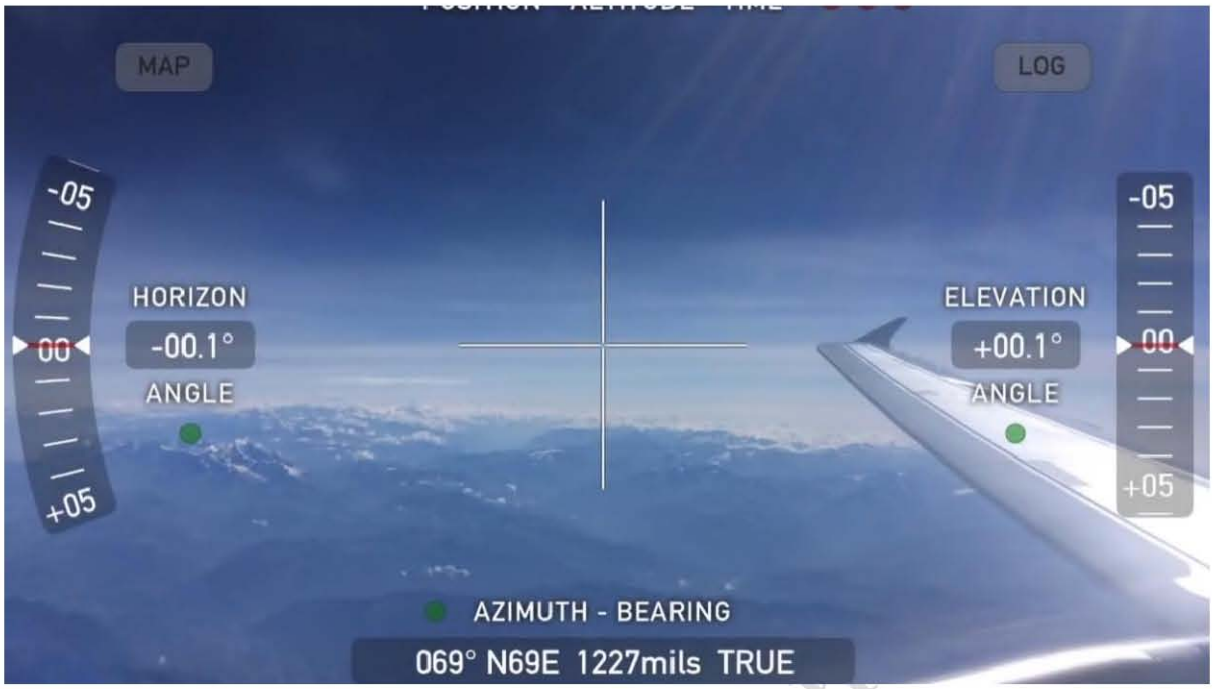


Obviously we will check before each takeoff that the application works as expected (if necessary we will calibrate it!):

The following examples are taken from Olivier Joseph:

https://youtu.be/96HEy-3ucA8?t=790

With in-flight measurements:



Or with the additions:

Or another one that summarize everything:

These are some great empirical examples of "armchair geodesy"... that prove the Earth is not flat!

Alternatively, there is also a video available here from an anonymous pilot:

https://www.youtube.com/watch?v=9DDwx18JT9Y

translati

And which also demonstrates in the video that the cockpit window of the aircraft where the video was filmed does not distort the vision (projection plane):

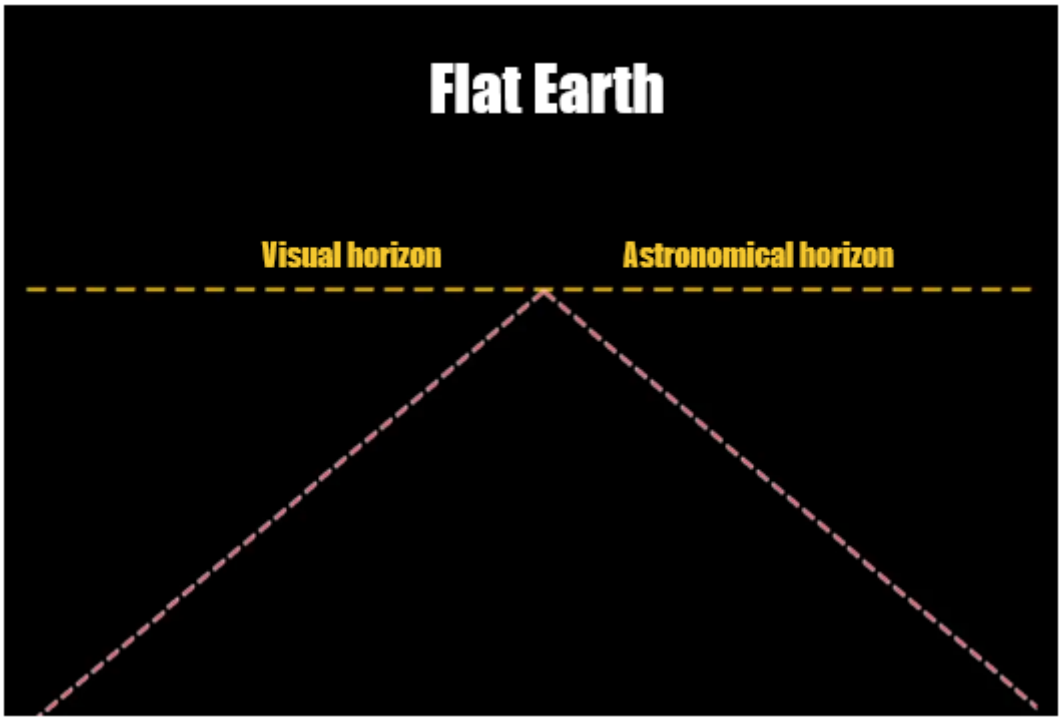
https://www.youtube.com/watch?v=i4T9YsSwYcc&feature=youtu.be

He did also the same test with the lens of the camera used:

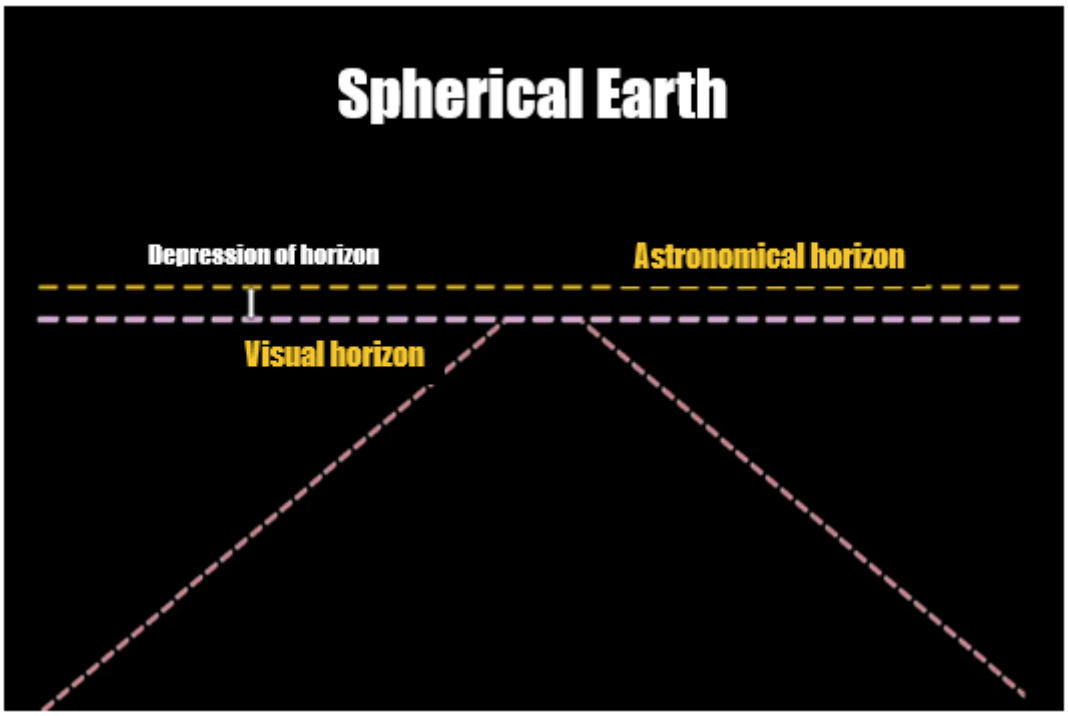
https://www.youtube.com/watch?v=d8vb1VbAQFA

(#086) Depression angle via boat wakes

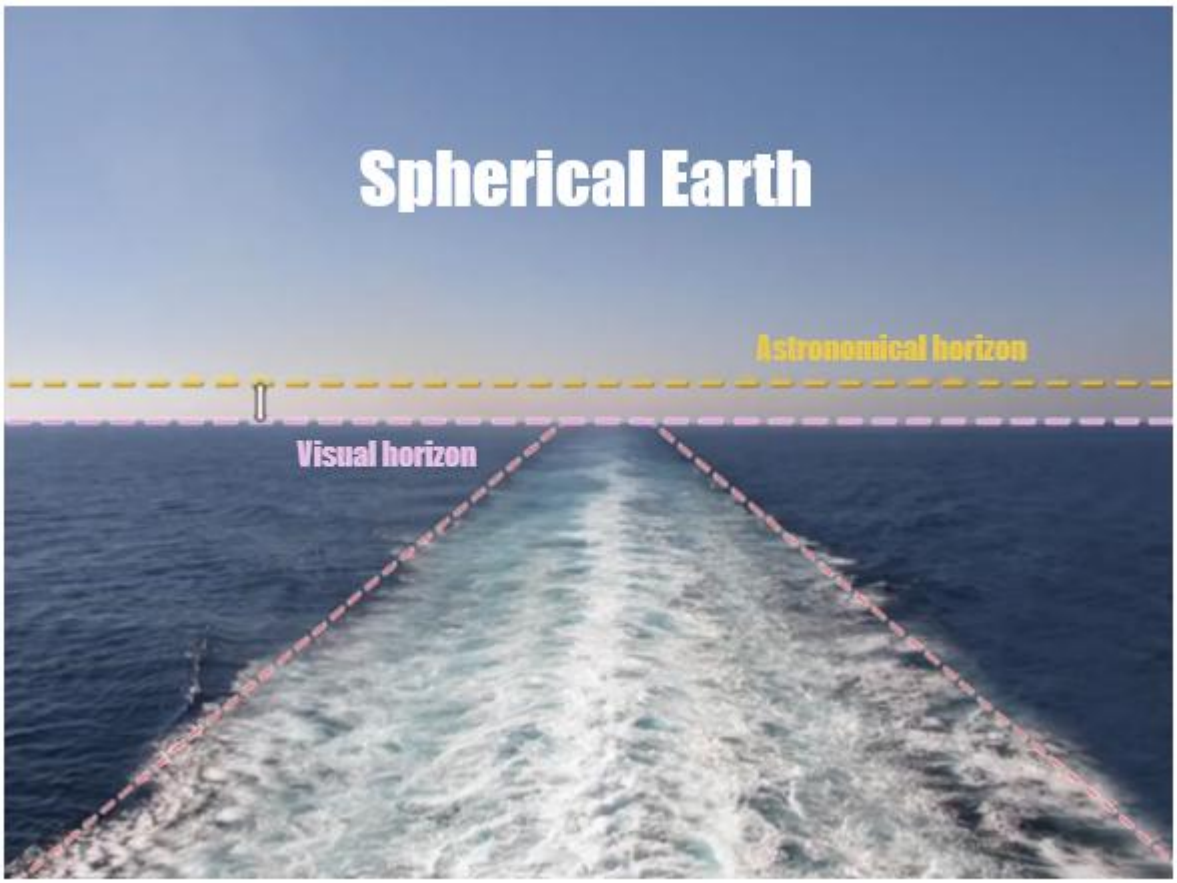
On a flat Earth, according to the laws of linear perspective, we should have:



On a curved Earth (like a spherical Earth for example), we will have:



And what can we observe with the wakes of the large boats:



Moreover, this wake allows us to calculate the radius of the Earth (Lynch, 2005):

$$R = \frac{W^2 - \omega^2 H^2}{2H\omega^2}$$

Fig. 4. Simulation of a ship wake on a round Earth. The wake converges but does not come to a point. It has a finite width of the apparent horizon, which is below the geometrical horizon by an amount α_D, the so-called "dip."

in this case 0.18 degrees. This angle is well known to celestial navigators[5] (e.g., Bowditch, 1995) and is called "dip." Equations (1) and (2) are almost trivial derivations, and they have been done by many authors.

Figure 4 shows the simulation of the wake on the real Earth. Near the horizon, it does not come to a sharp point but instead becomes slightly rounded and is flat topped at the apparent horizon. The angular width of the wake ω at the apparent horizon is simply

$$\omega = W/D_T, \tag{3}$$

where W is the wake's physical width. By substituting D_T from Eq. (1) into Eq. (3) and solving for R, we obtain

$$R = (W^2 - \omega^2 H^2)/(2H\omega^2), \tag{4}$$

where every quantity on the right-hand side is known or measurable. From $W = 30$ m, $H = 32$ m, and a rough measurement of $\omega = 4.6$ arcminutes, we find that $R = 7.85 \times 10^3$ km, tolerably close to the true value of 6.38×10^3 km given the simplicity of the analysis. We could also have substituted Eq. (1) into Eq. (2) and solved for R, but the dip could not be obtained from Fig. 1. Figure 5 shows $\omega(W)$ for various values of H for a reasonable range of expected observing conditions. Also shown is the position of the observations based on Fig. 1.

3. Discussion

The unrefracted distance to the horizon D_T is ~20 200 m, but the refracted value[6] is closer to 22 100 m. Using French's expression for distance analogous to Eq. (1) results in a cubic equation in R. The refracted solution was obtained from a web-based cubic equation solver (and checked with a second solver)[7] and found to be 6.55×10^3 km. We

Fig. 5. $\omega(W)$ for various values of H. The dot marks the location of the calculations based on Fig. 1.

mention refraction here to show that accurate determinations are possible. But ancient sailors would not have had the training or tools to derive French's equation or solve a cubic equation. They might, however, have been able to draw Fig. 3 and solve the geometry for R, and this would have lead to a reasonably accurate determination of the radius of the Earth.

Could extinction play a role in the horizon's visibility by lowering the contrast of the sky–sea boundary to the point of hiding the actual horizon? Not in this case. According to Bohren and Fraser,[8] even in the clearest of air, the horizon ceases to be visible when the observer is higher than ~2000 m above the sea. In the case of Fig. 1, the air was extremely clear and the observer was only at an elevation of 32 m, making his judgement of where the horizon was, and therefore the angular width of the turbulent wake, reasonably secure.

Our assumption of a fixed width of the turbulent wake is not strictly true. The bubbles in the turbulent wake will gradually diffuse laterally, the amount being dependent on turbulent motions from the ship and its propulsion system. Observations and computations[9,10] show that the spreading rate is very slow, varying roughly as the one-fourth power of the distance behind the ship. Thus the width of the wake is its initially width, i.e., roughly the beam of the ship, to which a slowly growing component must be added. The effect of including wake broadening in the calculations above would be to increase the derived radius of the Earth.

Modern ships move much faster than old ships, and it is likely that modern wakes endure longer and with greater visual contrast than did those of older, slower ships. Being slower and not screw driven, it would have taken longer for an old sailing vessel to reach a point where their wake was on the horizon, and its wake may well have dissipated. On the other hand, older ships were smaller, and the height at which an observer could get to might only have been around 5–10 m, corresponding to a horizon distance of 8–11 km. At a typical speed of 2 m/s, it would have taken

translation ongoing

In this same scientific publication the author makes a real practical case and get for the radius of the Earth a value of 6,500 kilometers:

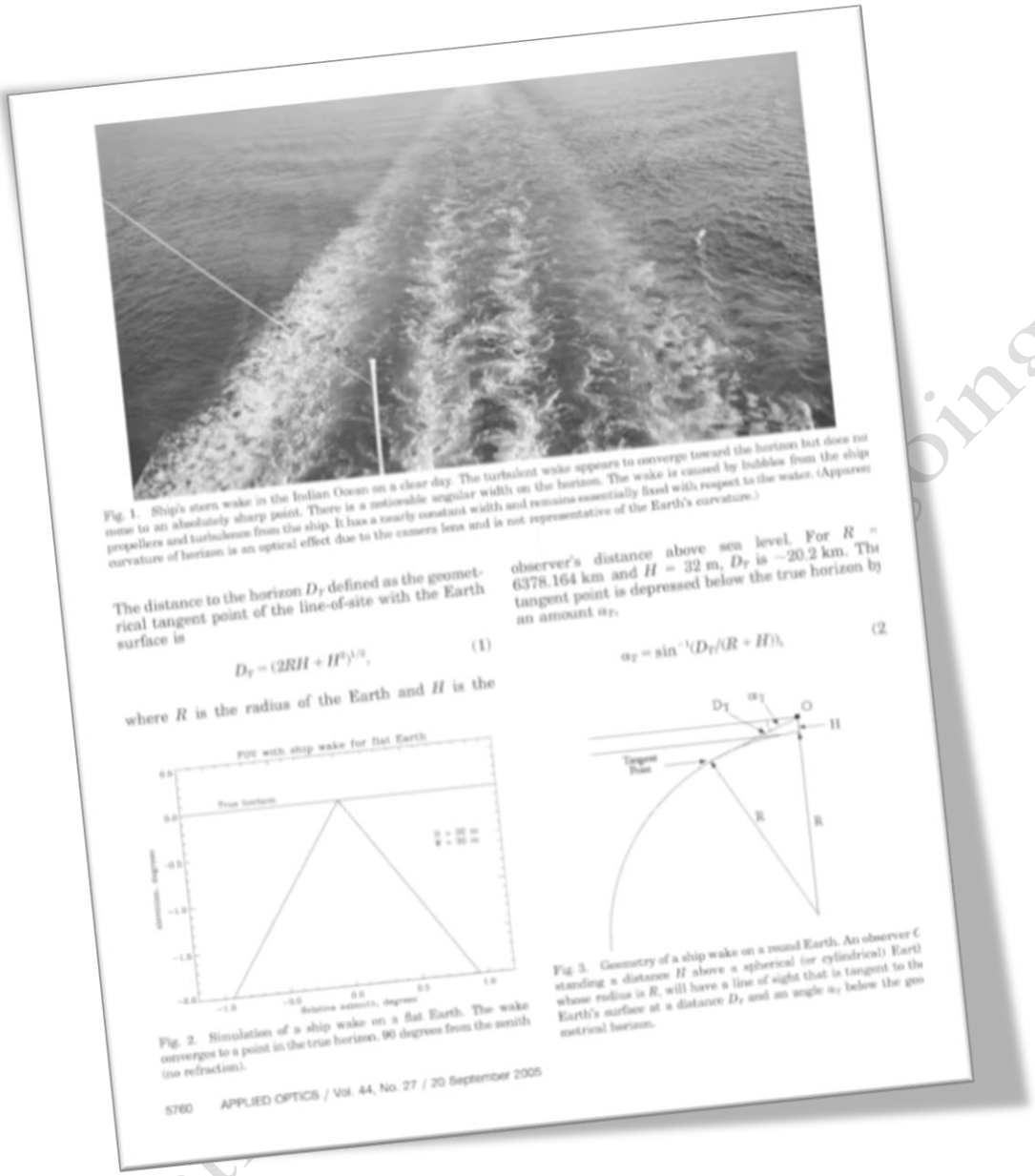


Fig. 1. Ship's stern wake in the Indian Ocean on a clear day. The turbulent wake appears to converge toward the horizon but does not come to an absolutely sharp point. There is a noticeable angular width on the horizon. The wake is caused by bubbles from the ship propellers and turbulence from the ship. It has a nearly constant width and remains essentially fixed with respect to the water. (Apparent curvature of horizon is an optical effect due to the camera lens and is not representative of the Earth's curvature.)

The distance to the horizon D_T defined as the geometrical tangent point of the line-of-site with the Earth surface is

$$D_T = (2RH + H^2)^{1/2}, \quad (1)$$

where R is the radius of the Earth and H is the observer's distance above sea level. For R = 6378.164 km and H = 32 m, D_T is ~20.2 km. The tangent point is depressed below the true horizon by an amount α_T,

$$\alpha_T = \sin^{-1}(D_T/(R + H)), \quad (2$$

Fig. 2. Simulation of a ship wake on a flat Earth. The wake converges to a point in the true horizon, 90 degrees from the zenith (no refraction).

Fig. 3. Geometry of a ship wake on a round Earth. An observer standing a distance H above a spherical (or cylindrical) Earth whose radius is R, will have a line of sight that is tangent to the Earth's surface at a distance D_T and an angle α_T below the geometrical horizon.

5760 APPLIED OPTICS / Vol. 44, No. 27 / 20 September 2005

So photographs and videos taken during sea cruises show curved horizons, even over distances of a few hundred kilometers or less. Visual evidence includes images captured aboard ships on the high seas, where the curvature of the water is visible.

General Relativity

Two results of General Relativity based on the sphericity of the Earth are in accordance with empirical observation and therefore experimental measurements.

(#087) Hafele-Keating experiment

The Hafele-Keating experimental results of General Relativity are incompatible with the non-spherical Earth model.

The Hafele-Keating experiment was an experimental test of general and special relativity conducted in October 1971 by Joseph Hafele and Richard Keating. It confirmed the prediction of the Langevin twin paradox (Around-the-World Atomic Clocks: Predicted Relativistic Time Gains, 1972).

Four synchronized atomic clocks circled the world twice, once eastward and once westward, on special flights. Compared to the arrival with another atomic clock that remained on the ground at the United States Naval Observatory (USNO), the clocks actually exhibited the time shift predicted by General Relativity.

Taking into account the different flight plans, the offsets predicted by the theory were:

- a delay of 40 ± 23 ns for clocks traveling eastward;
- an advance of 275 ± 21 ns for clocks traveling westward.

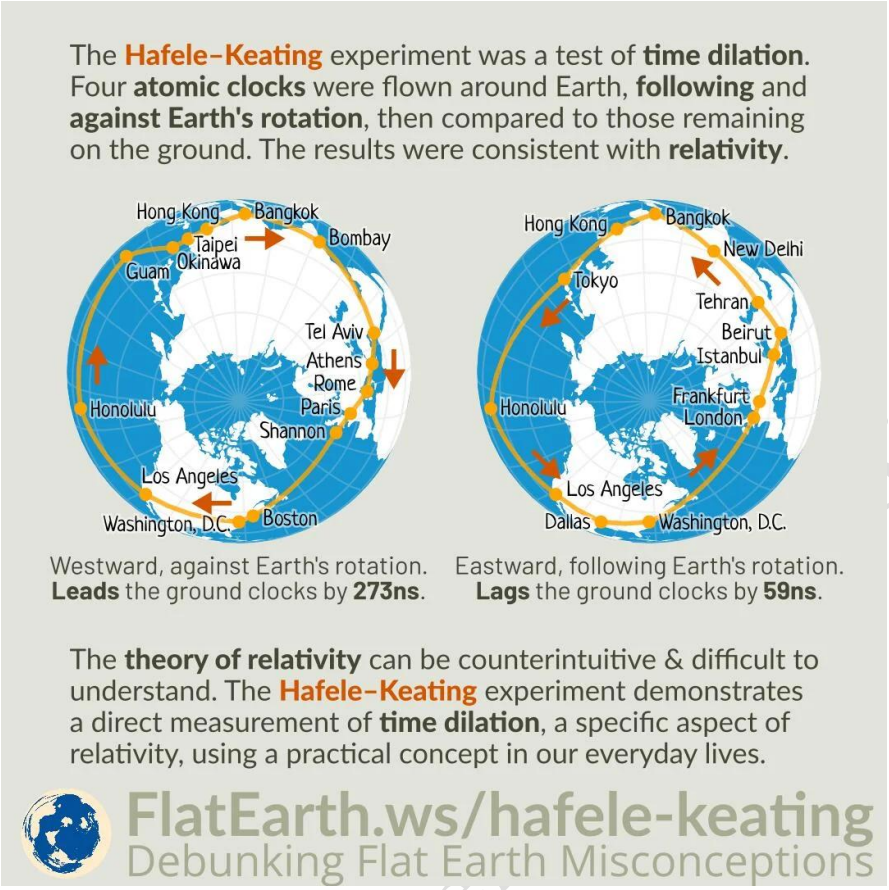
These shifts are due to three relativistic effects: a gravitational effect and the Sagnac effect and another kinematic effect of lesser importance.

The results obtained by the four clocks in both cases are in agreement with the theoretical predictions:

- a delay of 59 ± 10 ns for clocks traveling eastward;
- an advance of 273 ± 7 ns for clocks traveling westward.

The experiment was successfully replicated in 1975, 1996 and 2010.

translation into english ongoing



Note that this conformity with the theory is valid only because in the theoretical development in General Relativity of the Hafele-Keating effect, we use the Schwarzschild metric (Opera Magistris, 2024) which is, as a reminder, a metric with spherical symmetry (and not cylindrical as for a flat Earth...!):

$$g_{\mu\nu}x^{\mu}x^{\nu} = \mathrm{d}s^2 = \left(1 - \frac{2GM}{c^2 r}\right)c^2\mathrm{d}t^2 - \frac{1}{\left(1 - \frac{2GM}{c^2 r}\right)}\mathrm{d}r^2 - r^2(\mathrm{d}\theta^2 + \sin^2(\theta)\mathrm{d}\phi^2)$$

translation in progress

Figure 58 Hafele and Keating aboard a commercial airliner, with two of the atomic clocks

translation into english o

(#088) Gravity Probe B

Gravity Probe B (GP-B) was a NASA mission launched in 2004 to test two key predictions of Albert Einstein's theory of general relativity. The two effects in question were geodesics (the distortion of spacetime around a massive body like Earth) and frame-dragging (the twisting of spacetime caused by the rotation of a massive spherical body).

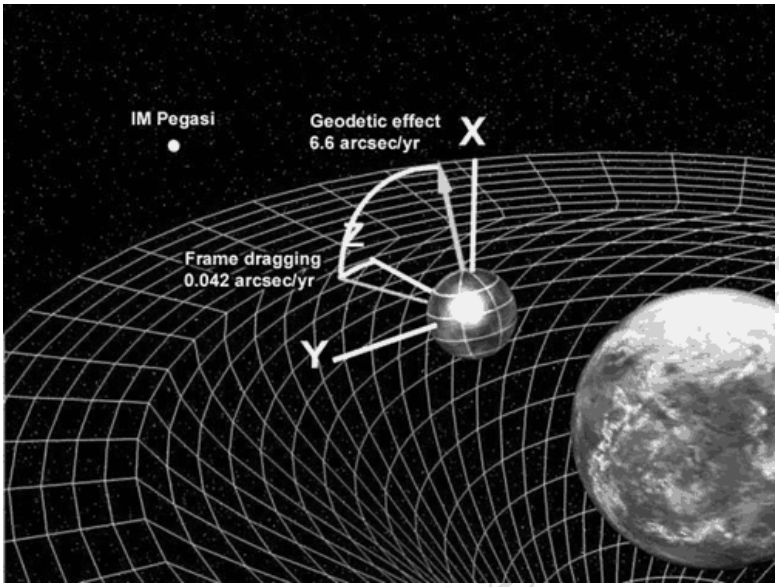


Figure 59 Principle of the gyroscope in the Gravity Probe B probe

To accomplish this, GP-B used four ultra-precise gyroscopes aboard a satellite in polar orbit around Earth. By measuring changes in the gyroscopes' rotation direction over time, the mission was able to detect the warps in spacetime predicted by Einstein. The results, published in 2011, confirmed the predictions of general relativity with remarkable accuracy.

Figure 60 Rotor and housing of the gyroscope of the Gravity Probe B experiment with housing

The spherical metric used in General Relativity for the analysis of this measurable, controllable and repeatable phenomenon is the Kerr metric which is a spherically symmetric metric (and not a cylindrical metric conforming to a flat Earth):

$$c^2\mathrm{d}\tau = \left(1 - \frac{r_s r}{\rho}\right)c^2\mathrm{d}t + \frac{\rho^2}{\Lambda^2}\mathrm{d}r^2 - \rho^2\mathrm{d}\theta^2 - \left(r^2 + \alpha^2 + \frac{r_s r\alpha^2}{\rho^2}\sin^2(\theta)\right)\sin^2(\theta)\mathrm{d}\phi^2 + \frac{2r_s r\alpha c\sin^2(\theta)}{\rho^2}\mathrm{d}\phi\mathrm{d}t$$

Where r_s is the Schwarzschild radius:

$$r_s = \frac{2GM}{c^2}$$

and :

$$\alpha = \frac{J}{Mc}$$

$$\rho = r^2 + \alpha\cos^2(\theta)$$

$$\Lambda^2 = r^2 - r_s r + \alpha^2$$

It is one of the most fascinating experiments conducted to test fundamental theories of physics!

Figure 61 Gravity Probe B before launch (source: NASA)

translation english ongoing

Gravity Probe B confirmed the geodesic effect and the frame-dragging effect as given by General Gelativity for the Eart , and the results are consistent with a geoid Earth but inconsistent with a flat Earth. This was to be accomplished by measuring, very precisely, tiny changes in the rotation direction of four gyroscopes contained in a satellite orbiting the Earth at an altitude of 650 km, directly crossing the poles. The first results confirmed the expected geodesic effect to an accuracy of about 0.5%, and the frame-dragging effect was confirmed to within 15% of the expected result. In a paper published in the journal *Physical Review Letters* in 2011 (Gravity probe B: final results of a space experiment to test general relativity, 2011), the authors reported that analysis of data from the four gyroscopes resulted in a geodetic drift rate of -6,601.8 ± 18.3 milliarcseconds per year and a frame-dragging drift rate of -37.2 ± 7.2 milliarcseconds per year, in good agreement with the predictions of General Relativity of -6606.1 ± 0.28% milliarcseconds per year and -39.2 ± 0.19% milliarcseconds per year, respectively.

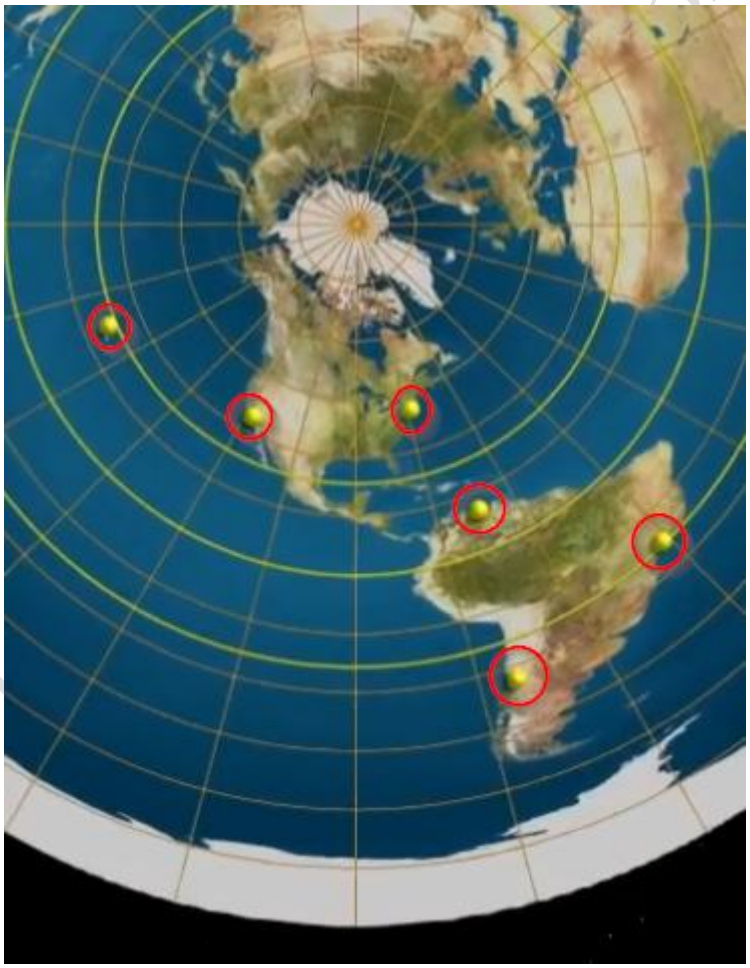
translation into english ongoing

(#089) Satellite TV Antennas

A satellite TV antenna is a device designed to capture signals emitted by satellites in geostationary orbit, allowing the reception of television channels, often in superior quality and over a wide geographical coverage. It consists of a dish, which concentrates the signals towards a receiver called an LNB (Low Noise Block), and a decoder to transform these signals into images and sounds. Unlike terrestrial antennas, it is not limited by distance or local obstacles, which makes it ideal for remote areas or areas poorly served by terrestrial networks. Its particularity lies in its orientation precision, essential for capturing signals coming from a fixed point in space.

The following explanations and illustrations are inspired and taken from Jos Leys (see his YouTube video here: https://www.youtube.com/watch?v=hfEnjC4EaUk).

Let's sign up for satellite service in the following six cities: New York, Los Angeles, Honolulu, Caracas, Santiago, and Rio de Janeiro, represented on a flat Earth by:



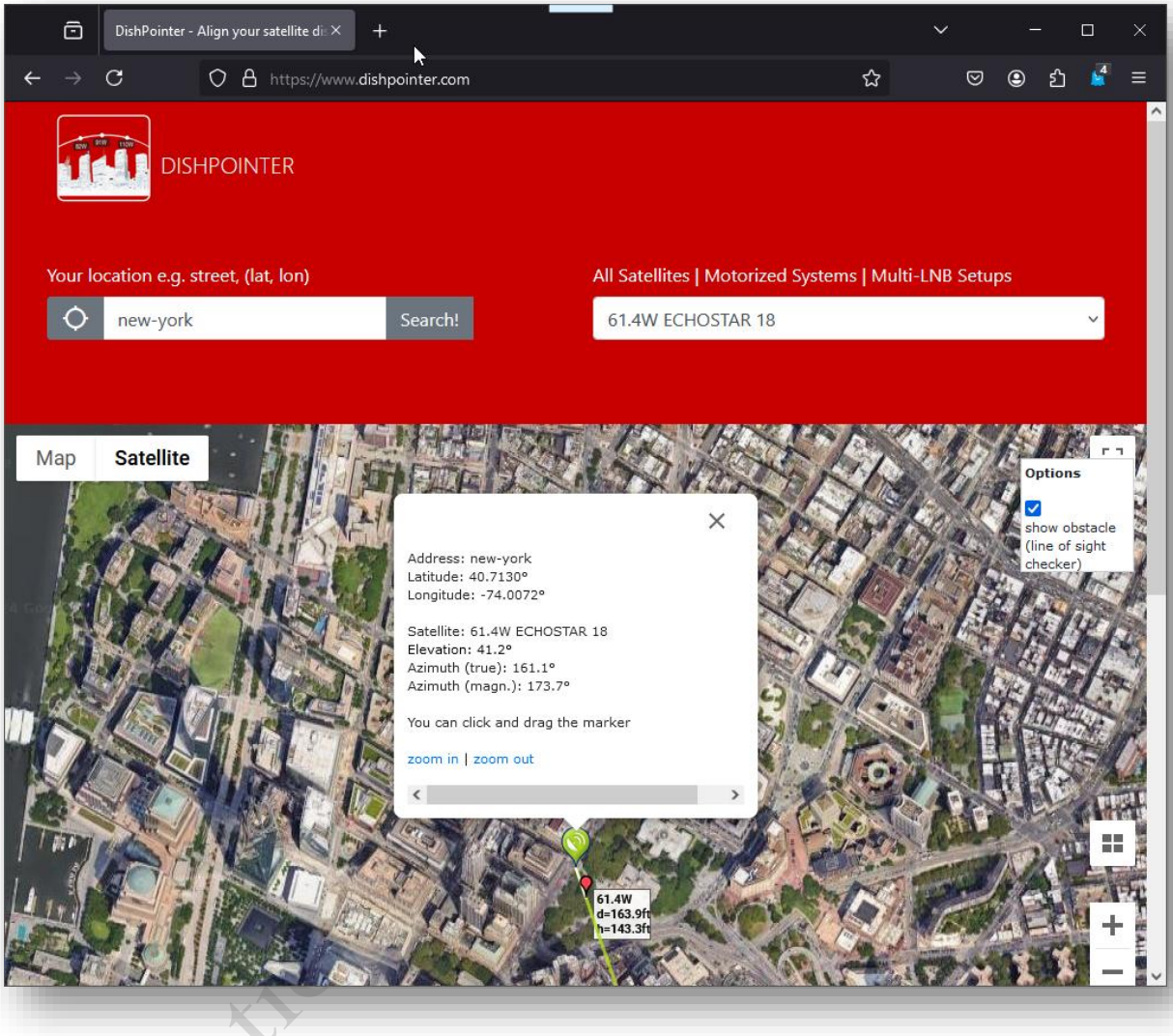
Our provider uses Echostar 12, also known as the Rainbow 1 satellite.

Let's align the corresponding satellite dishes in each city !

To do this, we will consult the following website:

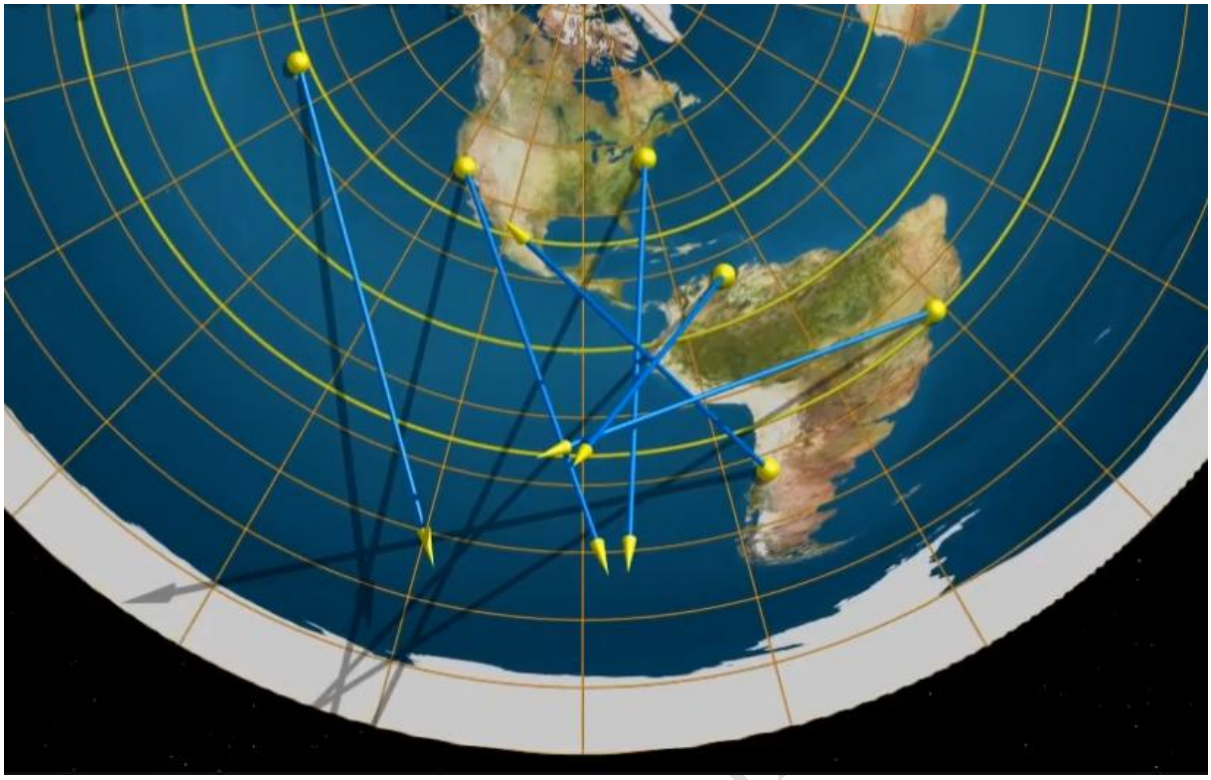
https://www.dishpointer.com

We can then read the azimuth and elevation for example for New York:



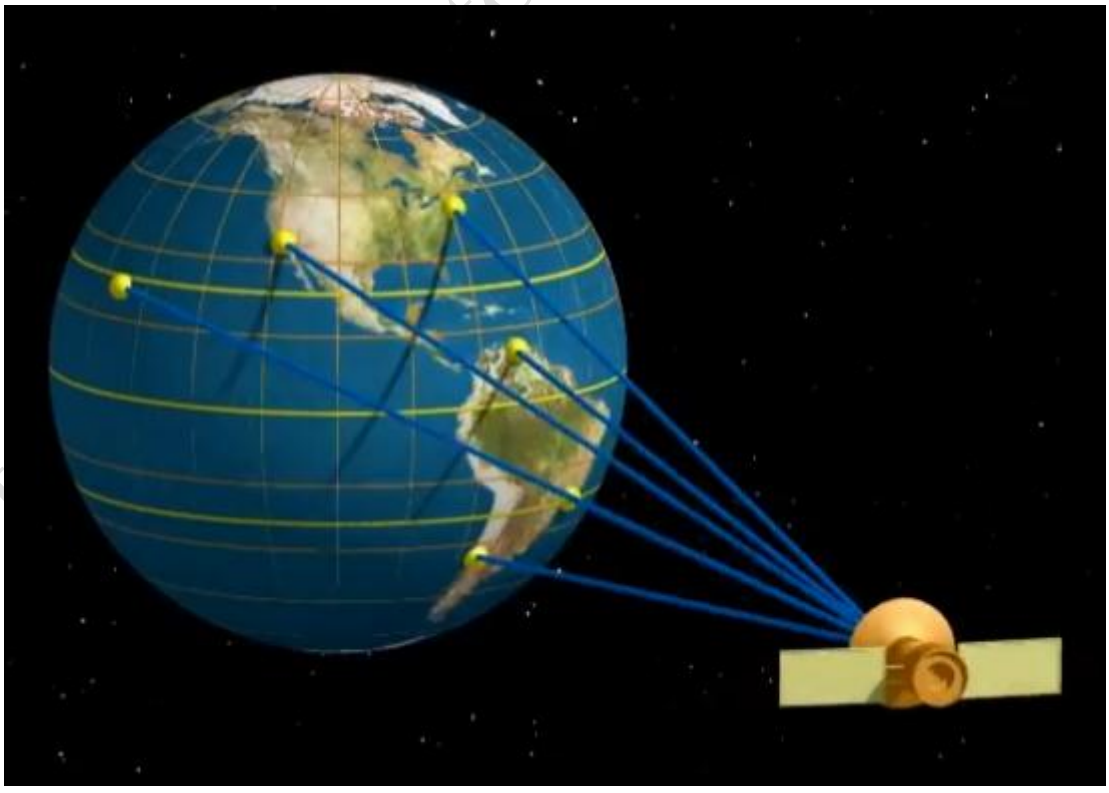
Let's plot the azimuths and elevations on the flat Earth map:

translation



Obviously there is a problem. Either the satellite is quantum because it is in multiple places at the same time, or the flat Earth model is wrong.

On the other hand, on a globe there is no inconsistency:



Plane routes

We're going to look at over 40 commercial and airliner flights that make no sense on a flat Earth (we'll stop at 40 because there are obviously many more!):

QFA63, QFA64, QR1364, QR908, MAU440, MAU441, SAA280, QFA27, SAA280, SAA281, ANZ3180, ANZ3181, VOZ5020, VOZ5021, ANZ161, ANZ162, SAA7080, SAA7081, ANZ175, ANZ176, ANZ177, ANZ178, LAN804, LAN805, QFA5027, QFA5028, QFA27, QFA20, LAN806, LAN807, ANZ30, ANZ31, LAN800, LAN801, QFA31, QFA322, DTA745, DTA746, DTA747, DTA748, DTA749, DTA750, SAA222, SAA223, TAM8058, TAM8059, LAN8058, LAN8059…

To put it simply, there are three classic cases to consider:

- The time-distance metric on several commercial journeys which is totally incompatible with the model of flat Earth believers (on a flat Earth for the journey to be feasible, planes would often have to go twice as fast...).

- The route of some commercial flights remains only in the southern hemisphere in the real world, whereas according to the flat Earth believers it would pass through the northern and southern hemispheres for obvious reasons of saving time and therefore money.

- The trajectories of airplanes on a plane (stereographic projection) form arcs as one would expect on a globe. But on the flat Earth the connections are straight lines, which is not consistent with observed reality.

To illustrate just the three problems mentioned above, we have the following illustration which summarizes this for some commercial aircraft routes which we will detail later:

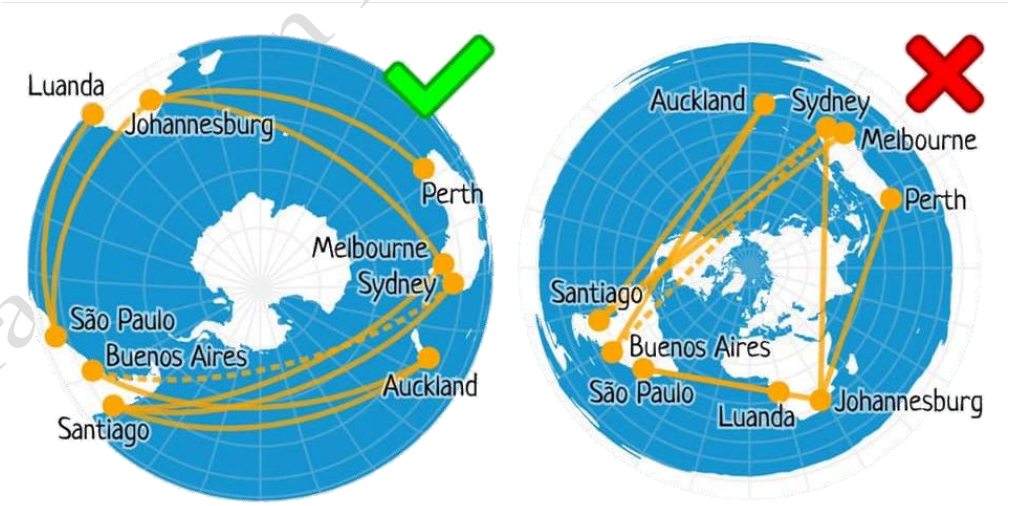


Figure 62 Flight routes from Earth to Globe vs. Flat Earth (source: FlatEarth.ws/southern-flight)

Keep this illustration in mind for what follows!

translation into english ongoing

Please note that all flight details are from: https://www.flightradar24.com and distances have been calculated and verified with:

https://walter.bislins.ch/bloge/index.asp?page=Distances+on+Globe+and+Flat+Earth

For those who want a scientific article that statistically demonstrates the likelihood of the oblate Earth in a highly reputable scientific journal, see: (A novel estimator of Earth's curvature (allowing for inference as well), 2024)..

Circumpolar flights (with stopovers)

First, a definition: "*Circumnavigation refers to sailing around a place, commonly an island, a continent, or the entire Earth*."

At the day we write these lines, 7 airplanes have flown around the world via the poles:

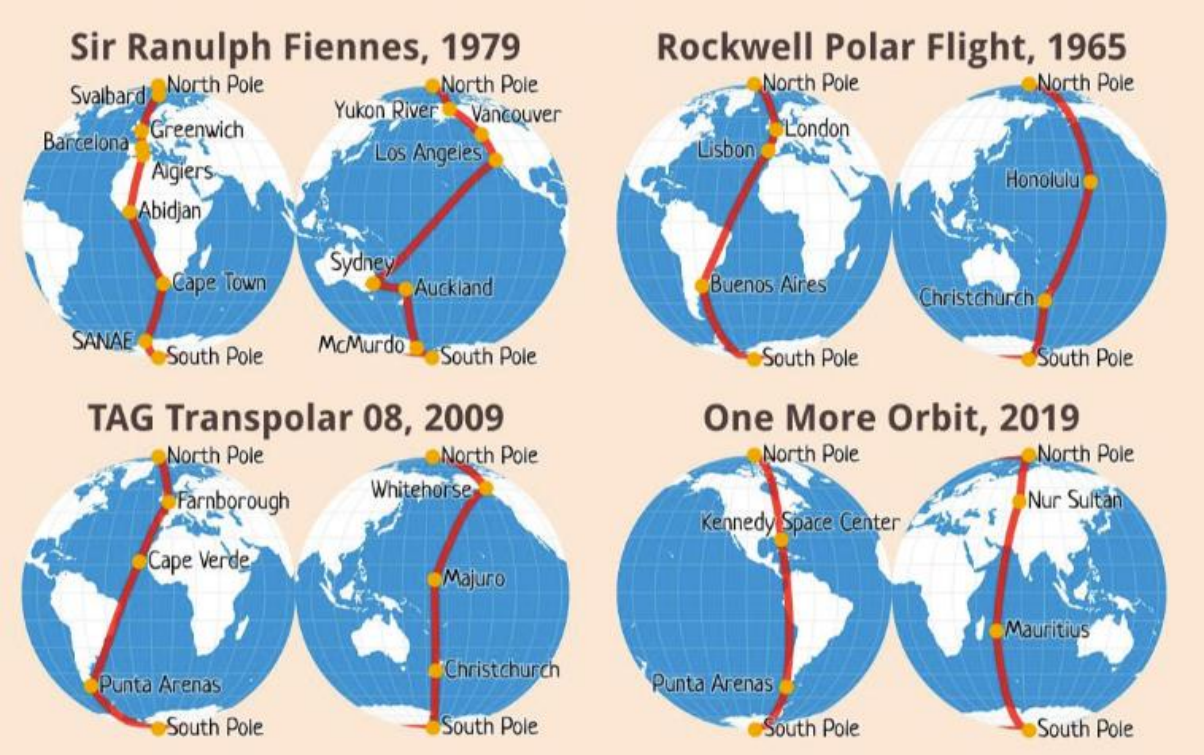


Figure 63 World tours via the poles by plane (source : https://flatearth.ws/polar-circumnav)

Polar circumnavigation is a complete voyage around the Earth, passing through the North and South Poles. Several people have accomplished this, and it is only possible if the Earth is a sphere !

Flat Earth proponents falsely claim that the Earth has never been circumnavigated via both poles, and they use this to "prove" that the Earth is flat. In reality, many people have achieved such feats:

- from November 14 to 17, 1965, Captain Fred Lester Austin, Jr. and Harrison Finch took off from Honolulu, USA, to circle the Earth via both poles.

  Route: Honolulu, United States – North Pole – London, United Kingdom – Lisbon,

Portugal – Buenos Aires, Argentina – South Pole – Christchurch, New Zealand – Honolulu, United States.

- In 1977, Pan Am Flight 50 circled the Earth via the North and South Poles to celebrate Pan Am's 50th anniversary.

  Route: San Francisco, USA – North Pole – London, UK – Cape Town, South Africa – South Pole – Auckland, New Zealand – San Francisco, USA.

- in 1979, Sir Ranulph Fiennes and Charles R. Burton set out from Greenwich, UK, for the South Pole, then traveled north to the North Pole and back to Greenwich. The Guinness Book of World Records records this journey as the first surface circumnavigation of the polar sea.

  Route: Greenwich, United Kingdom – Cape Town, South Africa – South Pole – Auckland, New Zealand – Sydney, Australia – Los Angeles, United States – Vancouver, Canada – Yukon River, Canada – North Pole – Greenwich, United Kingdom.

- in 1988-1989, Dick Smith flew around the world via both poles in a Twin Otter aircraft.

- in 1992, Michael Palin made a documentary for the BBC about his journey from the Arctic to the South Pole.

  Route: North Pole – North Base, Greenland – Svalbard, Norway – Norway – Helsinki, Finland – Leningrad, Soviet Union (now St. Petersburg) – kyiv, Soviet Union (now Ukraine) – Odessa, Soviet Union – Istanbul, Turkey – Limassol, Cyprus – Cairo, Egypt – Khartoum, Sudan – Addis Ababa, Ethiopia – Nairobi, Kenya – Serengeti, Tanzania – Lusaka, Zambia – Victoria Falls, Zimbabwe – Cape Town, South Africa – Rio de Janeiro, Brazil – Santiago, Chile – South Pole.

- in 2009, the TAG Transpolar08 flight circled the Earth, passing through the North and South Poles, breaking the speed record at the same time, with an average speed of 822.8 km/h.

  Route: Farnborough, United Kingdom – North Pole – Whitehorse, Yukon, Canada – Majuro, Marshall Islands – Christchurch, New Zealand – South Pole – Punta Arenas, Chile – Sal, Cape Verde – Farnborough, United Kingdom.

- from July 9 to 11, 2019, to commemorate the Apollo 11 moon landing, the One More Orbit team broke the polar circumnavigation record aboard the Gulfstream G650ER aircraft.

  Itinerary: Kennedy Space Center, FL, USA – North Pole – Nur Sultan, Kazakhstan – Port Louis, Mauritius – South Pole – Punta Arenas, Chile – Kennedy Space Center, FL, USA.

translation into english ongoing

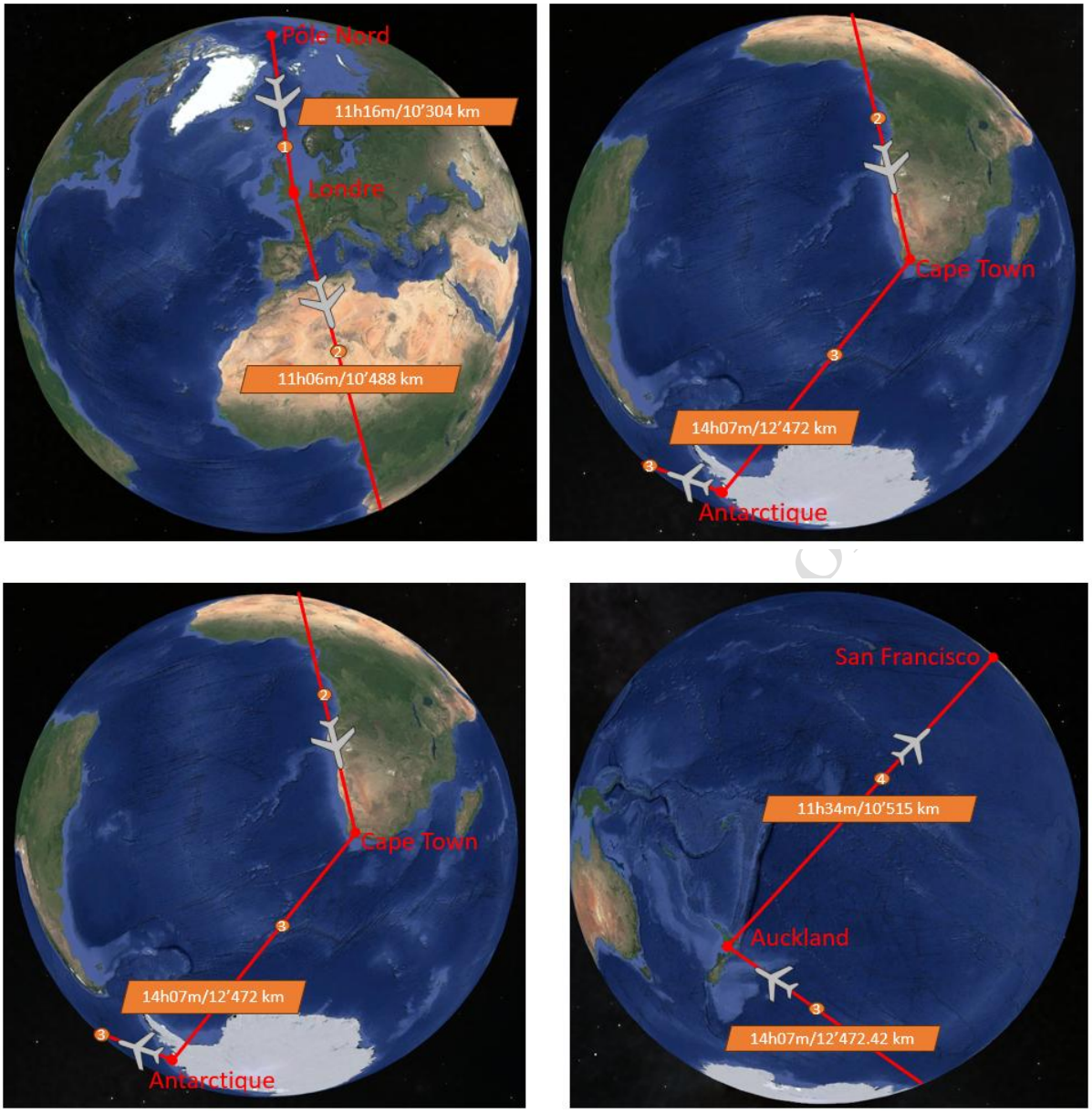
(#090) World Tour by the Poles by Pan Am PA50 (1977)

From October 28th to 30th, 1977, the American airline (founded in Florida) Pan Am organized flight number PA50 to celebrate the company's 50th anniversary. The itinerary of this special flight included a world tour via both poles.

For this commemoration, the company used a Boeing 747SP-23 from its fleet, registered N533PA and renamed "Clipper New Horizons" for the occasion. The aircraft already had a certain celebrity, having broken records during a World Tour flight in 1976.

To complete its flight 50, the company planned a route that departed from and returned to San Francisco with three stopovers: London, Cape Town, and Auckland. The longest intermediate route was the 14-hour flight from Cape Town to Auckland. A real feat for the time. To increase the distance, the number of passengers was limited, and each person was only allowed to carry a small piece of cabin baggage with just enough to change their clothes.

translation into en



Miss America and Miss Universe were among the passengers on the flight from the beginning. They were joined by Miss England at the London stopover, then by Miss South Africa in Cape Town, and finally by Miss New Zealand in Auckland. The hand-picked cabin crew provided 14 gourmet meal services, and passengers were treated to several screenings of classic films, lavished with gifts and souvenirs.

Countdowns were announced before each pole flyby, followed by champagne toasts. The airline even hosted a Gucci fashion show with the flight crew.

The previous special bicentennial flight was so popular that some of those who had taken it returned for Flight 50, which was even advertised in the Wall Street Journal. Within three days, the seats were sold out. Passengers were willing to spend $2,200 (equivalent to $9,800 in 2020) for a weekend trip around the world and, in the process, make aviation history.

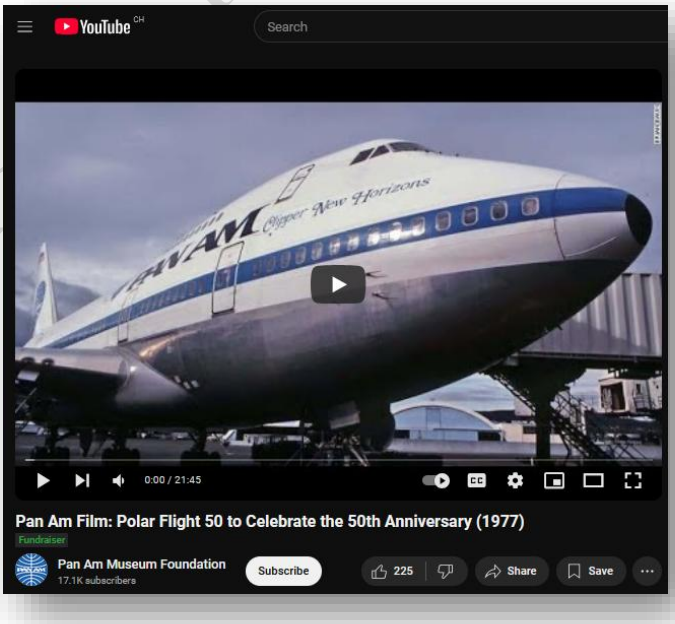
This journey, which has only been made three times with airliners, lasted 54 hours and 12 seconds at an average speed of 784 km/h. The first flight between the two poles was made in 1965 with a modified 707-349C from the Flying Tiger company with 40 people on board, mostly scientists, and lasted 62 hours and 27 minutes. In 1968, a Convair 990 with 78 passengers and crew also flew over the two poles, making one of its stopovers for refueling at McMurdo Station in Antarctica. This made this flight the only one to have landed on all seven continents for its circuit. In 2018, a project, without follow-up, The Polar Express, was to offer a world tour via the poles aboard an Airbus A340-300 at a cost of 10,000 euros per person. The club of passengers who have flown over the two poles therefore remains limited to this day.

The SP, or Special Performance, version of the Boeing 747-100 was designed to offer a greater range. The design study was launched by Boeing in 1973 following a specific request from Pan Am, the 747's launch airline. For the American airline, the aim was to be able to connect New York to Tehran non-stop. Iran Air, which would also be a customer of this version, made the same request. For Boeing, the SP would also allow it to compete directly with the DC-10 and L-1011 tri-jets, where the -100 version was excessive in terms of capacity.

Technically, the SP differs from the -100 by a fuselage shortened by 15.35 meters. The aircraft now has only 4 doors instead of 5 on each side. The reduction in length was compensated by an increase in the height of the tail. The "Baby Jumbo" could carry 276 passengers in three classes over 10,800 kilometers. On July 4, 1975, the SP made its first flight, it was certified on February 4, 1976, and entered service with Pan Am the same year. Boeing had planned to build 200 of them, but ultimately only 45 were assembled. The most famous of which is still in service today, equipped with the SOFIA telescope.

A 20-minute video dedicated entirely to the subject is available on Pan Am's YouTube channel:

https://www.youtube.com/watch?app=desktop&v=9phjmBEhYsw



translation into english ongoing

(#091) World Tour by the Poles TransPolar08 (2008)

The TransPolar08 crew flew around the world via the North and South Poles aboard a Bombardier Global Express, decreasing by 95 minutes the record previously held by a Pan Am Boeing 747SP that made the trip in October 1977. The team of the swiss Aziz Ojjeh (a Syrian businessman) completed the journey in 52 hours and 32 minutes, at an average ground speed of 822.288 kilometers per hour.

translation into e ing

(#092) World Tour by the Poles One More Orbit (2019)

46 hours 39 minutes and 38 seconds. This is the new world record time set by the mission dubbed One More Orbit after circumnavigating the globe via both poles. The G650ER twin-engine jet landed at the Kennedy Space Center in Florida at 4:12 p.m. Mauritius time, with an average speed of 860.95 kilometers per hour in July 2019. The swiss Aziz Ojjeh had held the world record since 2008, with an average speed of 822.8 kilometers per hour.

Figure 64 One More Orbit's journey over the poles (illustration courtesy of One More Orbit)

(#093) Antipodal flights (with stopovers)

Auckland, New Zealand, and Madrid, Spain, form a near-antipodal pair. They are located at diametrically opposite points on the Earth's surface. Therefore, we can fly from Auckland in any direction and arrive in Madrid after traveling a roughly similar distance, regardless of the direction taken.

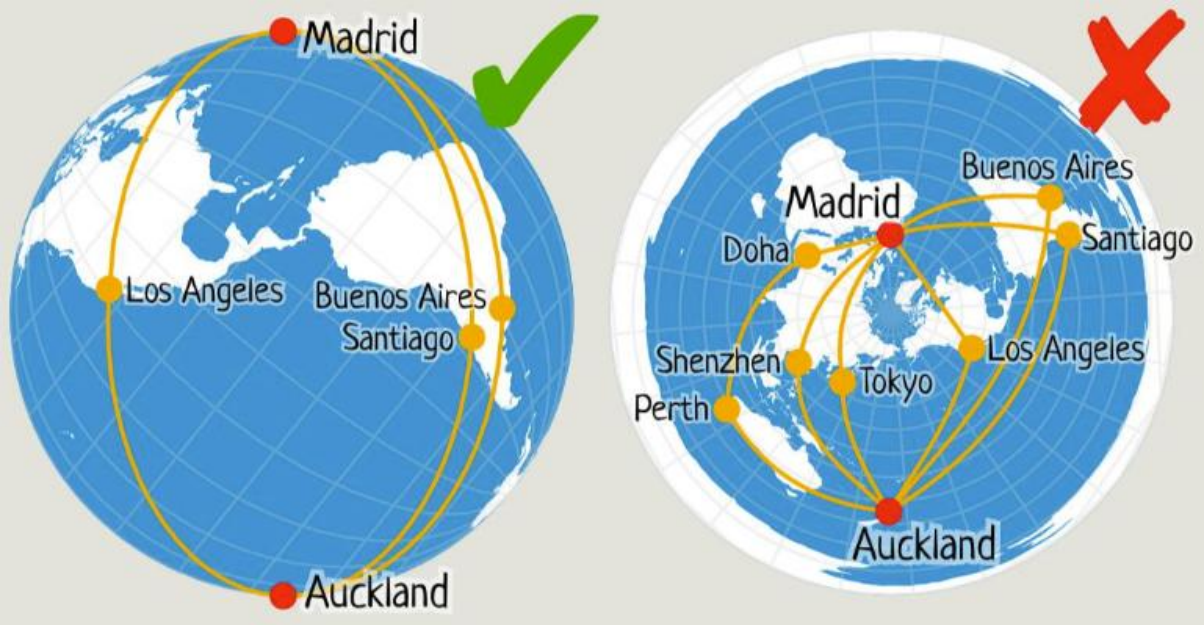


Figure 65 Antipodal flights Madrid-Auckland (source: https://flatearth.ws/auckland-madrid)

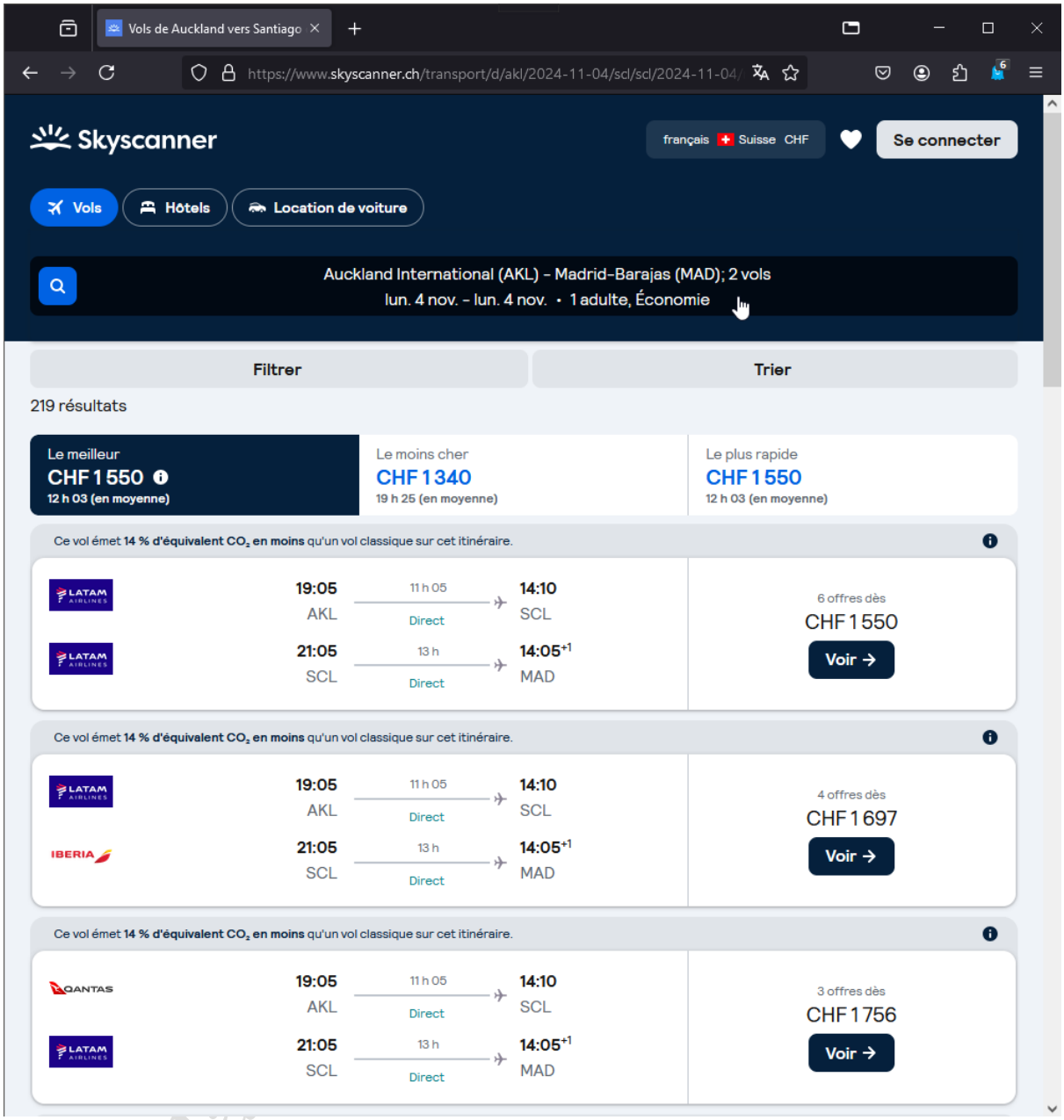
Any flight between an antipodal pair has a similar duration, even if the different flights have different directions. This fact is only consistent with a spherical Earth and cannot be explained if the Earth is flat.

For example, on a flat Earth, the flight route Auckland-Tokyo-Madrid is almost a straight line between the two locations. In contrast, Auckland-Santiago-Madrid involves a massive detour and should take much longer than the aforementioned straight line. However, contrary to what one would expect from the flat Earth model, both routes have similar flight times.

These flight times are from SkyScanner as of October 2024:

Auckland–Santiago–Madrid : 11 h 0 + 12 h 40 = 23.67 hours

translation into e


Vols de Auckland vers Santiago
https://www.skyscanner.ch/transport/d/akl/2024-11-04/scl/scl/2024-11-04/
Skyscanner
français Suisse CHF
Se connecter
Vols
Hôtels
Location de voiture
Auckland International (AKL) – Madrid-Barajas (MAD); 2 vols
lun. 4 nov. – lun. 4 nov. • 1 adulte, Économie
Filtrer
Trier
219 résultats
Le meilleur
CHF 1 550
12 h 03 (en moyenne)
Le moins cher
CHF 1 340
19 h 25 (en moyenne)
Le plus rapide
CHF 1 550
12 h 03 (en moyenne)
Ce vol émet 14 % d'équivalent CO₂ en moins qu'un vol classique sur cet itinéraire.
19:05 AKL 11 h 05 Direct 14:10 SCL
21:05 SCL 13 h Direct 14:05+1 MAD
6 offres dès
CHF 1 550
Voir →
Ce vol émet 14 % d'équivalent CO₂ en moins qu'un vol classique sur cet itinéraire.
19:05 AKL 11 h 05 Direct 14:10 SCL
21:05 SCL 13 h Direct 14:05+1 MAD
4 offres dès
CHF 1 697
Voir →
Ce vol émet 14 % d'équivalent CO₂ en moins qu'un vol classique sur cet itinéraire.
19:05 AKL 11 h 05 Direct 14:10 SCL
21:05 SCL 13 h Direct 14:05+1 MAD
3 offres dès
CHF 1 756
Voir →

- Auckland–Buenos Aires–Madrid : 11 h 45 + 11 h 35 = 23.33 hours
- Auckland–Los Angeles–Madrid : 12 h 15 + 11 h 5 = 23.33 hours
- Auckland–Tokyo–Madrid : 11 h 0 + 14 h 10 = 25.17 hours
- Auckland–Shenzen–Madrid : 11 h 45 + 14 h 0 = 25.75 heures
- Auckland–Perth–Doha–Madrid : 7 h 25 + 11 h 50 + 7 h 15 = 26.5 hours

There is also the same problem with Shanghai and Buenos Aires:

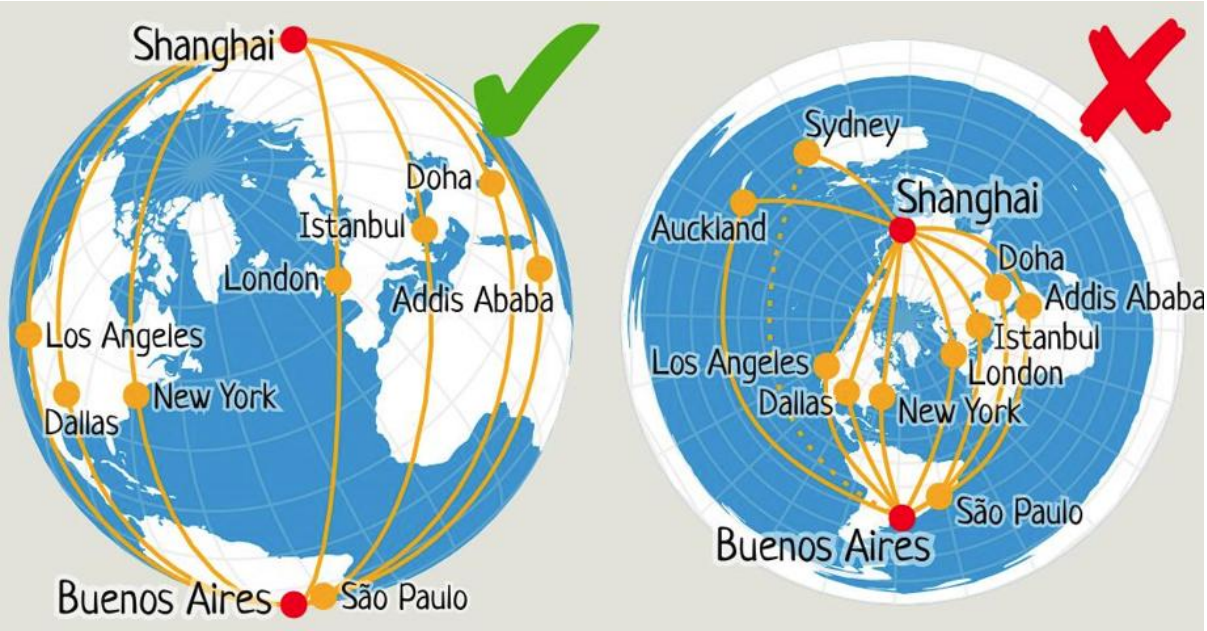


Figure 66 Antipodal flights Madrid-Auckland (https://flatearth.ws/auckland-madrid)

And the same checks as before can be done with SkyScanner (or other...).

translation into english

(#094) Direct QFA64 flight Johannesburg (South Africa) – Sydney (Australia)

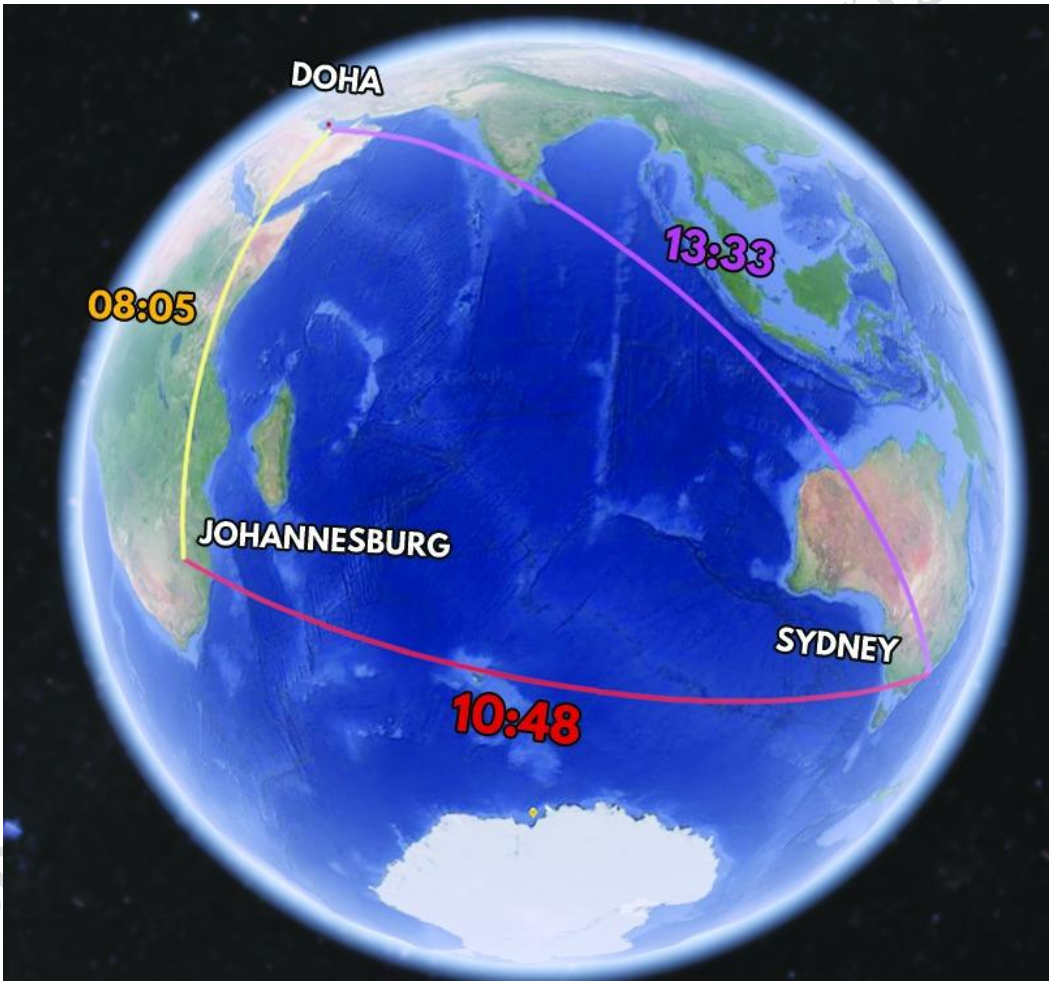
The path of flight QFA64 poses three problems for flattards:

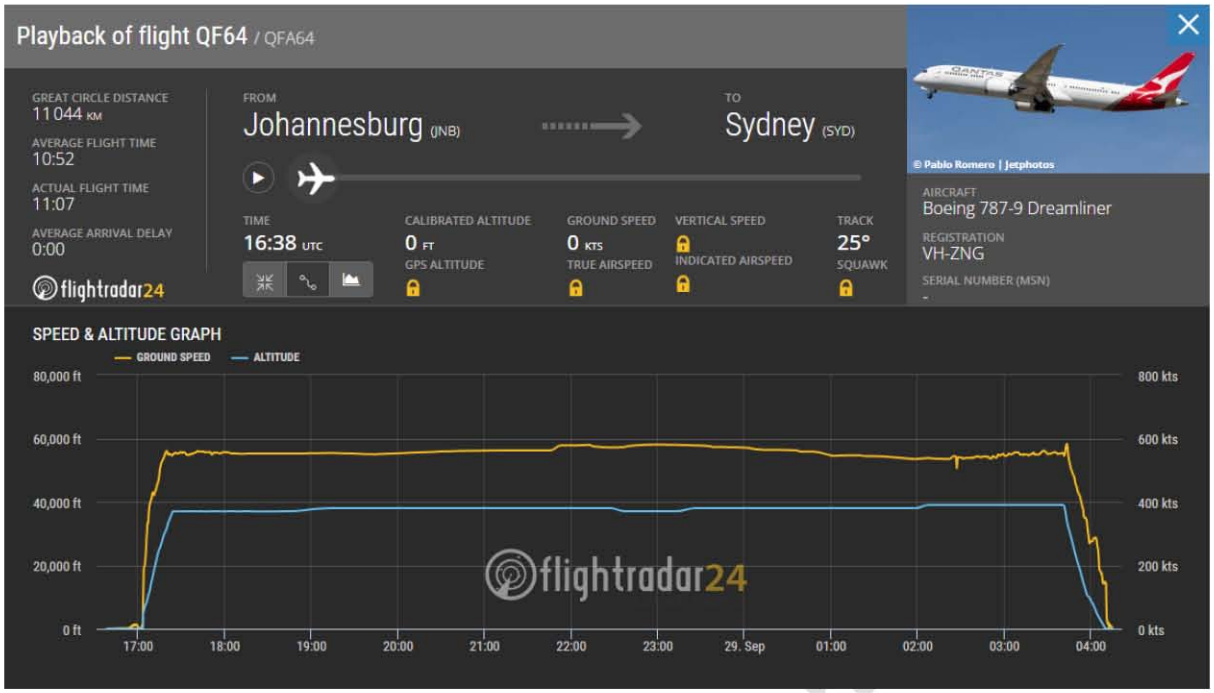
1. The average flight time of 10 hours and 52 minutes is less than that on a flat Earth since the distance is greater on the latter (11,044 kilometers on a globe compared to the 23,481 kilometers on a Gleason map).

2. On a flat Earth, the flight would pass through the Northern Hemisphere, whereas in reality it remains in the Southern Hemisphere.

3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.

This flight is illustrated below between Sydney and Johannesburg in red:





translation into english

(#095) Direct QFA63 flight Sydney (Australia) – Johannesburg (South Africa

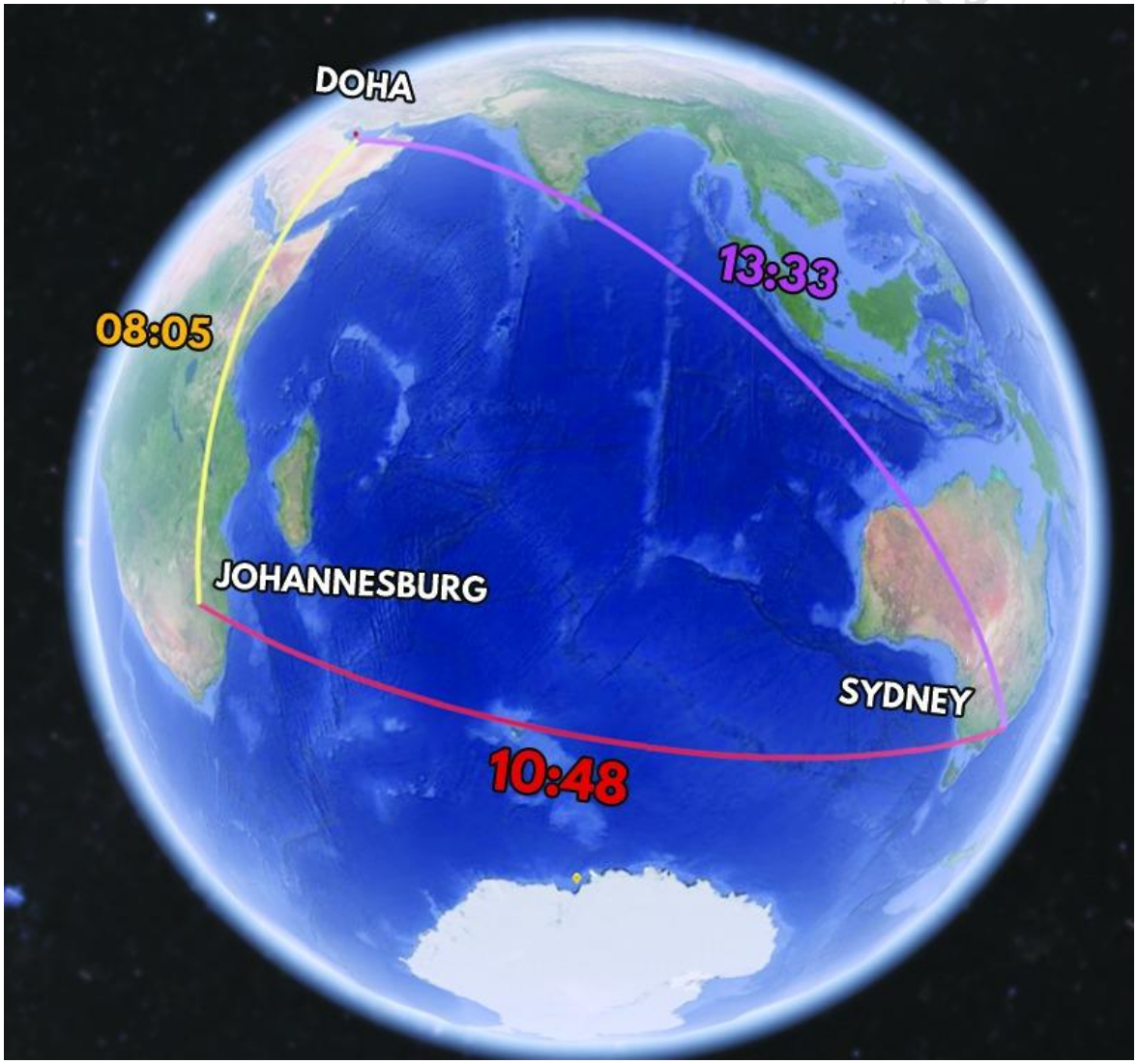
The path of flight QFA63 poses three problems for flattards:

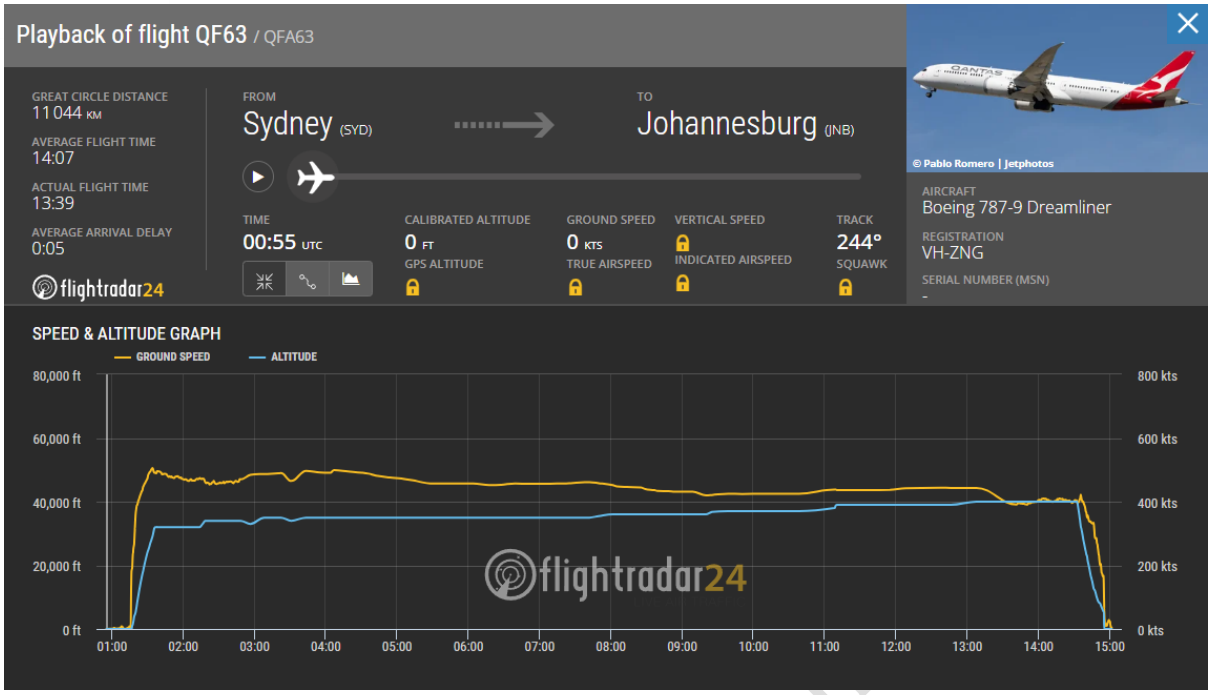
1. The average flight time of 14 hours and 7 minutes is less than that on a flat Earth since the distance is greater on the latter (11,044 kilometers on a globe compared to the 23,481 kilometers on a Gleason map).

2. On a flat Earth, the flight would pass through the Northern Hemisphere, whereas in reality it remains in the Southern Hemisphere.

3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.

This flight is illustrated below between Sydney and Johannesburg in red:





Furthermore, regardless of the direction of the Sydney-Johannesburg flight route, the travel times don't make sense (i.e., they are illogical) when compared to the flight times of flights with a stopover in Dubai, and this is assuming a flat Earth; whereas on a globe, it makes perfect sense.

The existence of the non-stop Sydney–Johannesburg flight route is only possible if Earth is a sphere. We can find that out by comparing its duration to the same route with a stop.
Dubai
07:55
13:40
Johannesburg
12:35
Sydney
Sydney
13:40
12:35
Dubai
07:55
Johannesburg
There are other Sydney–Johannesburg routes with a stop, like in Dubai. Flat-Earthers use them to "prove" a flat Earth. In reality, it does not mean the non-stop route does not exist & it is not difficult to verify the non-stop route exists.
FlatEarth.ws/sydney-johannesburg
Debunking Flat Earth Misconceptions

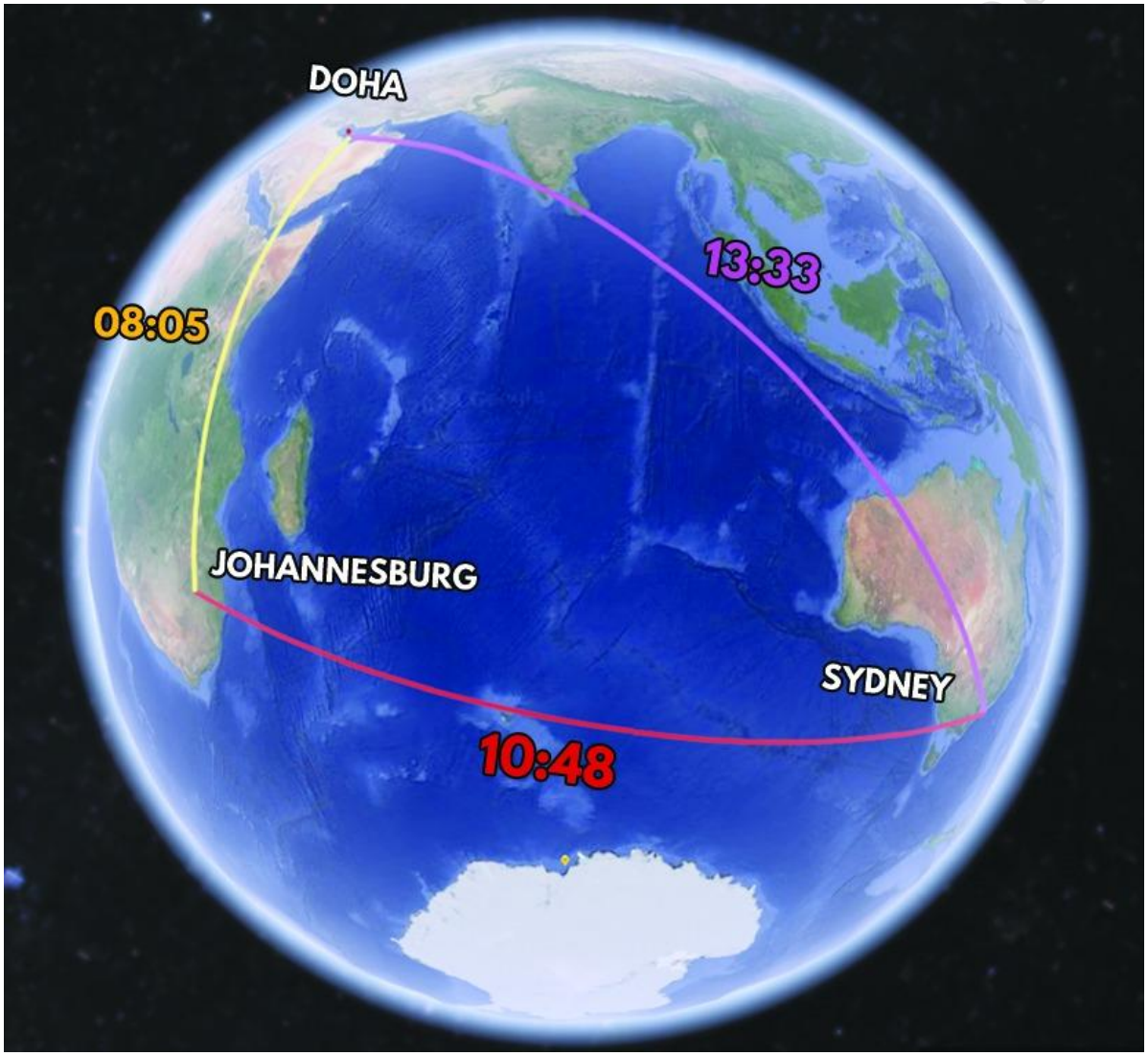
(#096) Direct QR1364 flight Johannesburg (South Africa) – Doha (Qatar)

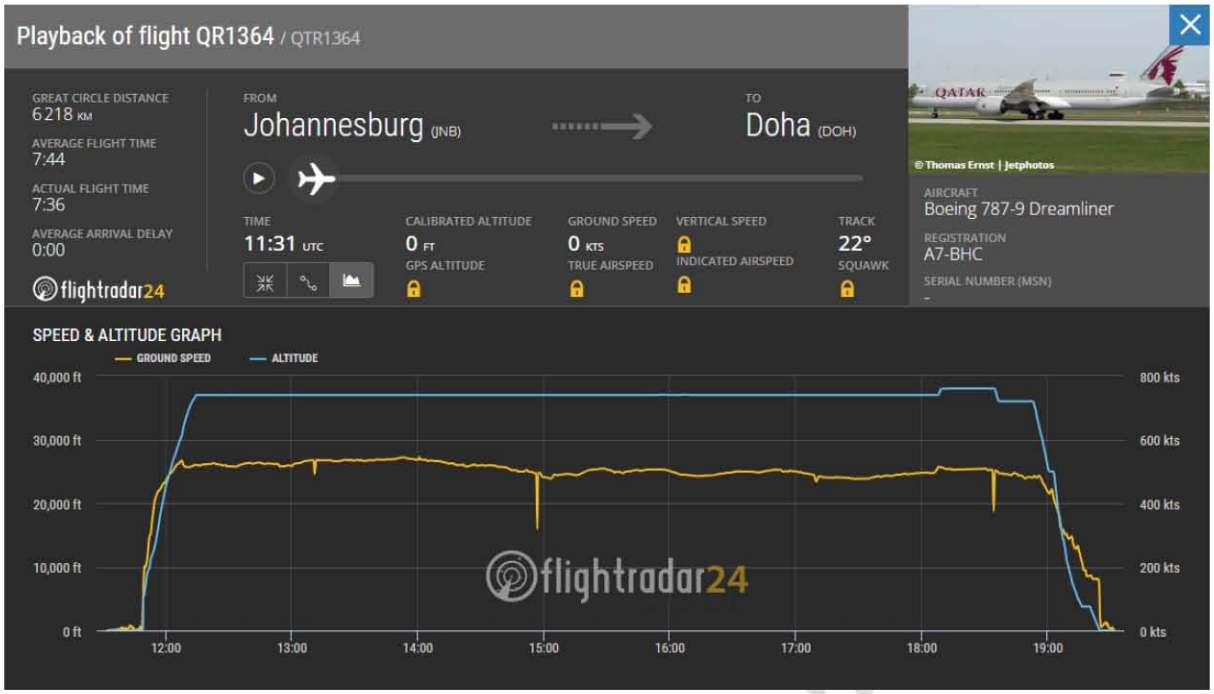
The flight path of QR1364 raises three problems for flat-Earthers:

1. The average flight time of 7 hours and 44 minutes is less than that on a flat Earth since the distance is greater on the latter (11,044 kilometers on a globe compared to the 23,481 kilometers on a Gleason map)

2. The paths are not straight lines projected onto a flat plane (loxodromes), but rather arcs, as they would appear on a globe (great circle routes).

This flight is shown below, between Johannesburg and Doha, in yellow:





translation into englis

(#097) Direct MAU440 flight Port Louis (Mauritius) – Perth (Australia)

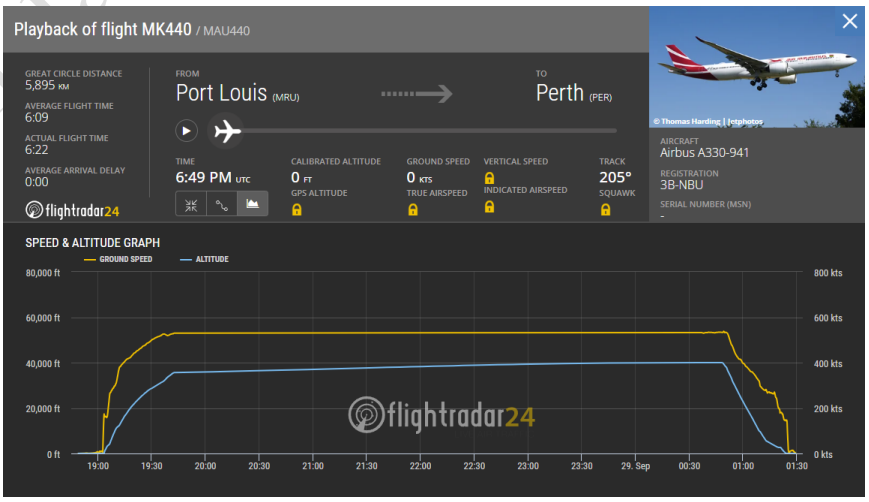
Direct flight from Mauritius (Sir Seewoosagur Ramgoolam International Airport) to Perth (Australia) on flight MAU440, average duration: 6 hours and 9 minutes:

The path of flight MAU440 poses three problems for flattards:

1. The average flight time of 6 hours and 9 minutes is less than that on a flat Earth since the distance is greater on the latter (5,895 kilometers on a globe compared to the 12,635 kilometers on a Gleason map).

2. On a flat Earth, the flight would pass through the Northern Hemisphere, whereas in reality it remains in the Southern Hemisphere.

3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation into english ongoing

(#098) Direct MAU441 flight Perth (Australia) – Port Louis (Mauritius)

Direct flight from Perth to Mauritius (Sir Seewoosagur Ramgoolam International Airport) flight MAU441, average duration: 8 hours and 12 minutes:

The path of flight MAU441 poses three problems for flattards:

1. The average flight time of 8 hours and 12 minutes is less than that on a flat Earth since the distance is greater on the latter (5,895 kilometers on a globe compared to the 12,635 kilometers on a Gleason map).

2. On a flat Earth, the flight would pass through the Northern Hemisphere, whereas in reality it remains in the Southern Hemisphere.

3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.

translation into English ongoing

(#099) Direct SAA280 flight Johannesburg (South Africa) – Perth (Australia)

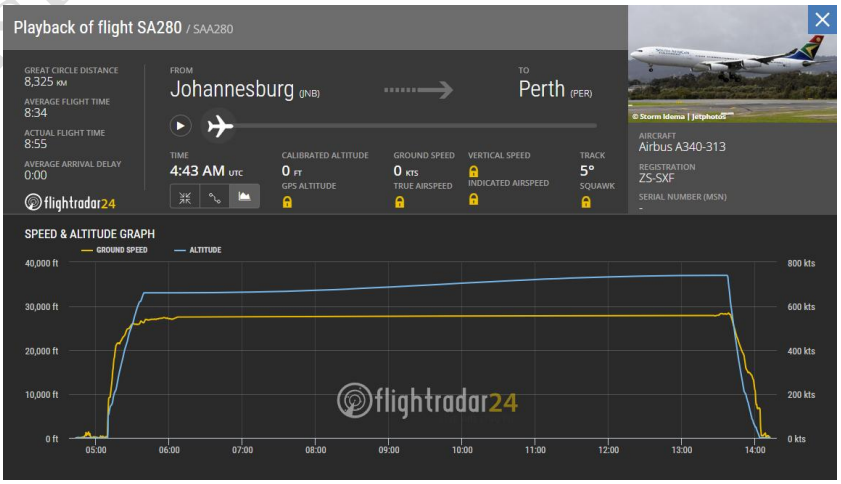
Direct flight from Johannesburg (South Africa) to Perth (Australia) on flight SAA280, average duration: 8 hours and 34 minutes:

The path of flight SAA280 poses three problems for flattards:

1. The average flight time of 8 hours and 34 minutes is less than that on a flat Earth since the distance is greater on the latter (8,325 kilometers on a globe compared to the 18,635 kilometers on a Gleason map).

2. On a flat Earth, the flight path would cross the Northern Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation into english ongoing

(#100) Direct SAA281 flight Perth (Australia) – Johannesburg (South Africa)

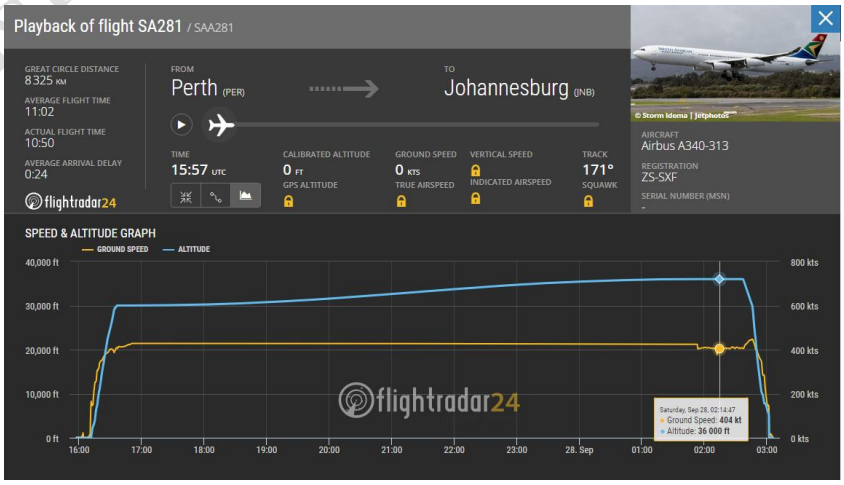
Direct flight from Perth (Australia) to Johannesburg (South Africa) on flight SAA280, average duration: 11 hours and 02 minutes:

The path of flight SAA281 poses three problems for flattards:

1. The average flight time of 11 hours and 02 minutes is less than that on a flat Earth since the distance is greater on the latter (8,325 kilometers on a globe compared to the 18,635 kilometers on a Gleason map).

2. On a flat Earth, the flight path would cross the Northern Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

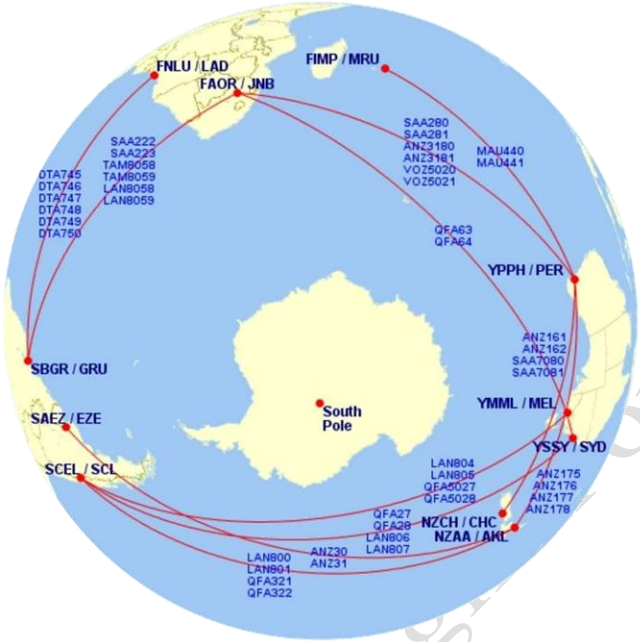
3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation in progress

(#101) Direct QFA27 flight Santiago (Chili) – Sydney (Australia)

Direct flight from Santiago (Chili) to Sydney (Australia) on flight QFA27 (but also the flights QFA28, LAN806, LAN807), average duration: 11 hours and 55 minutes:

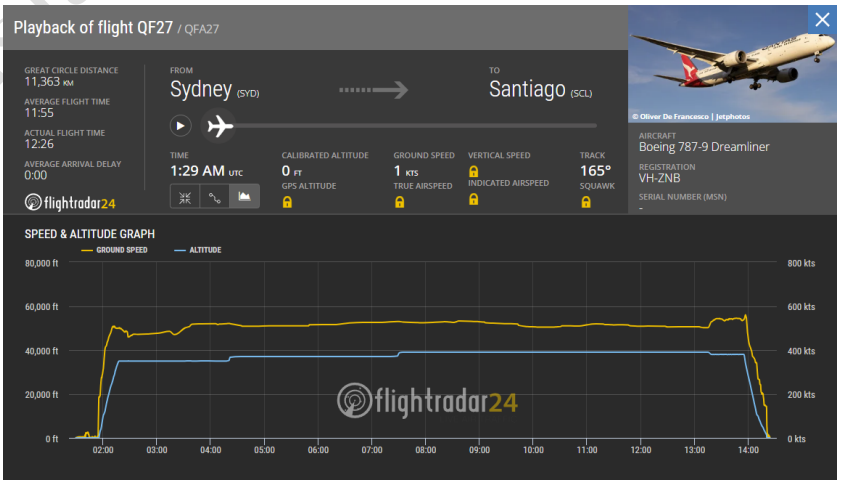


The path of flight QFA27 poses three problems for flattards:

1. The average flight time of 11 hours and 55 minutes is less than that on a flat Earth since the distance is greater on the latter (11,363 kilometers on a globe compared to the 26,585 kilometers on a Gleason map).

2. On a flat Earth, the flight path would cross the Northern Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

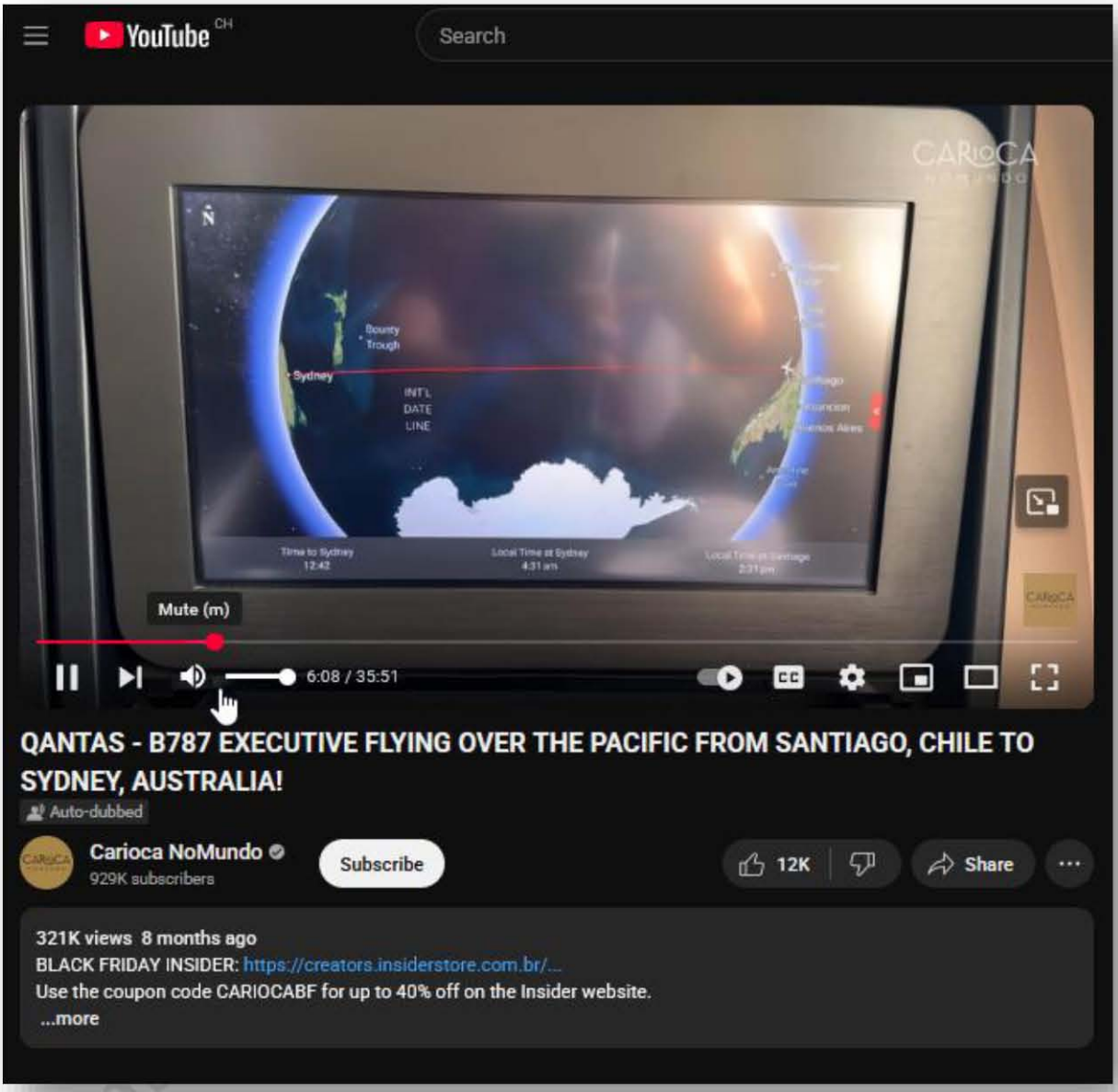
3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation into english ongoing

And here's a YouTube video with an executive who took that flight and recorded part of it:

https://www.youtube.com/watch?v=9ikNxbr6Phc



(#102) Direct QFA28 flight Sidney (Australia) – Santiago (Chili)

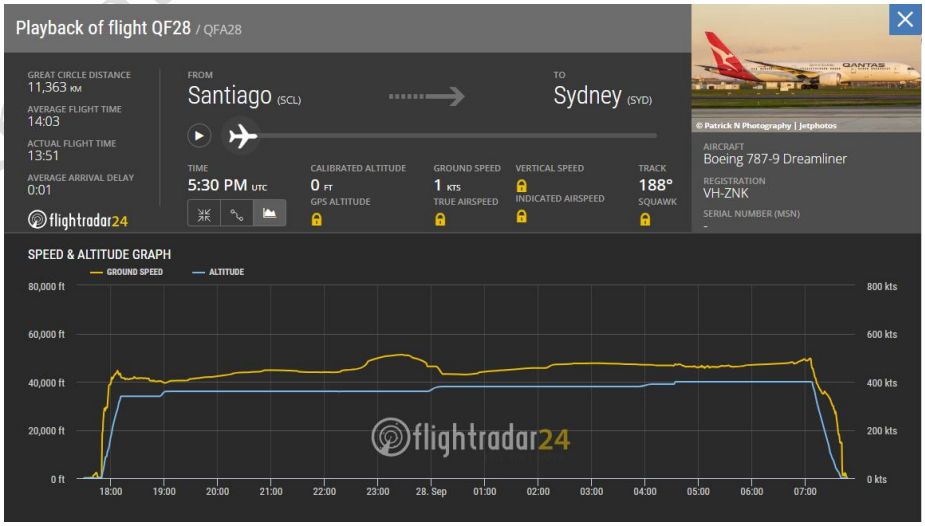
Direct flight from Sydney (Australia) to Santiago (Chili) on flight QFA28, average duration: 14 hours and 3 minutes:

The path of flight QFA27 poses three problems for flattards:

1. The average flight time of 14 hours and 3 minutes is less than that on a flat Earth since the distance is greater on the latter (11,363 kilometers on a globe compared to the 26 585 kilometers on a Gleason map).

2. On a flat Earth, the flight path would cross the Northern Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

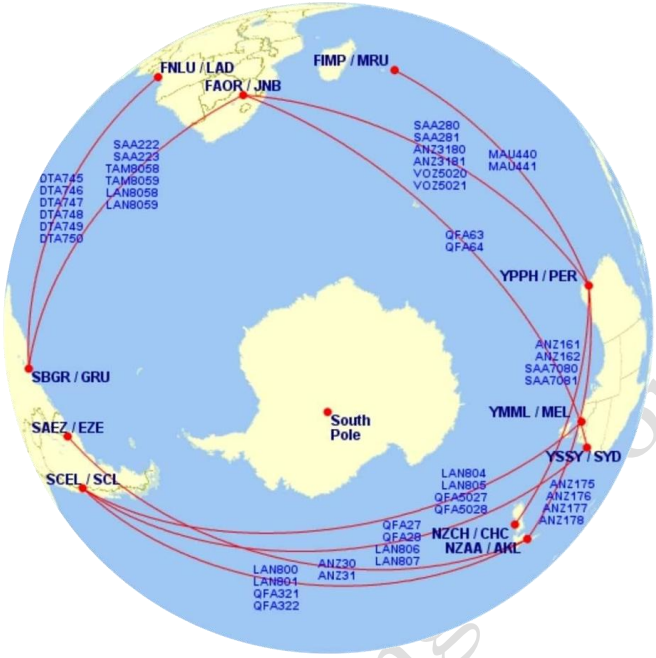
3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



traduction non officielle ongoing

(#103) Direct QFA20 flight Manille (Philippines) – Sydney (Australia)

Direct flight from Manille (Philippines) to Sydney (Australia) on flight QFA20, average duration: 7 hours and 24 minutes:

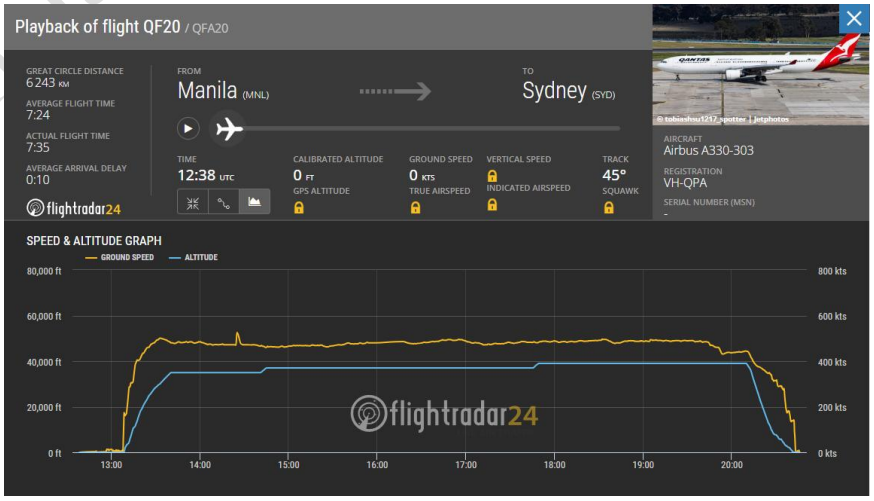


The path of flight QFA20 poses three problems for flattards:

1. The average flight time of 7 hours and 24 minutes is less than that on a flat Earth since the distance is greater on the latter (6,243 kilometers on a globe compared to the 7,771 kilometers on a Gleason map).

2. On a flat Earth, the flight path would cross the Northern Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

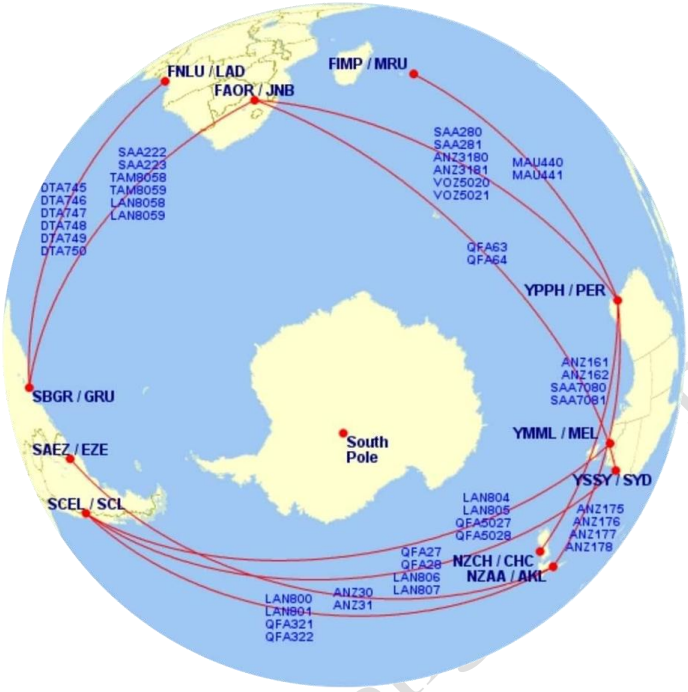
3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation into English ongoing

(#104) Direct QFA63 flight Sydney (Australia) - Johannesburg (South Africa)

Directe flight from Syndney (Australia) to Johannesburg (South Africa) on flight QFA63, average duration: 14 hours and 7 minutes.

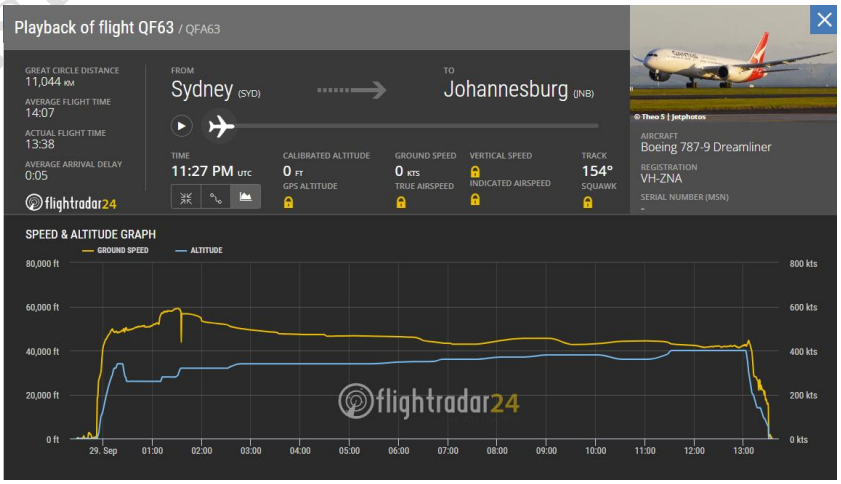


The path of flight QFA63 poses three problems for flattards :

1. The average flight time of 14 hours and 7 minutes is less than that on a flat Earh since the distance is greater on the latter (11 044 kilometers on a globe compared to the 23 481 kilometers on a Gleason map).

2. On a flat Earth, the flight path would cross the Northen Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

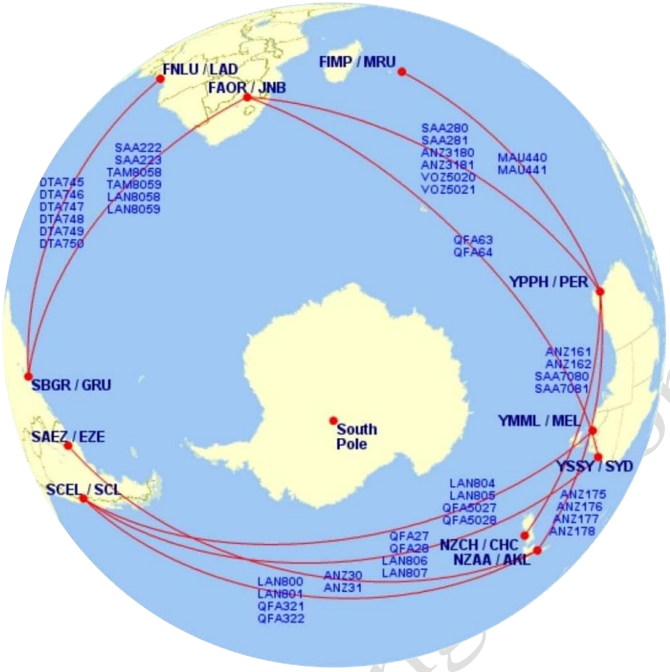
3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation in progress

(#105) Direct QFA64 flight Johannesburg (South Africa) – Sydney (Australia)

Direct flight from Johannesburg (South Africa) to Sydney (Australia) on flight QFA64, average duration: 10 hours and 52 minutes:

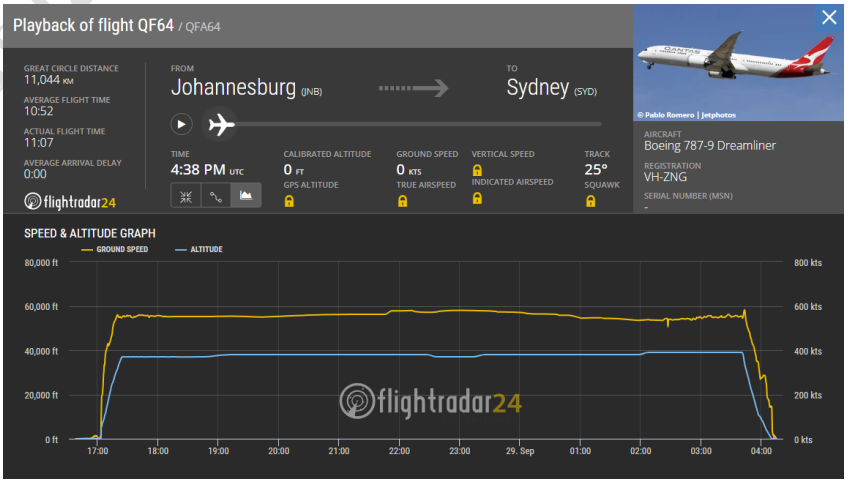


The path of flight QF64 poses three problems for flattards:

1. The average flight time of 10 hours and 52 minutes is less than that on a flat Earth since the distance is greater on the latter (11,044 kilometers on a globe compared to the 23,481 kilometers on a Gleason map).

2. On a flat Earth, the flight path would cross the Northern Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

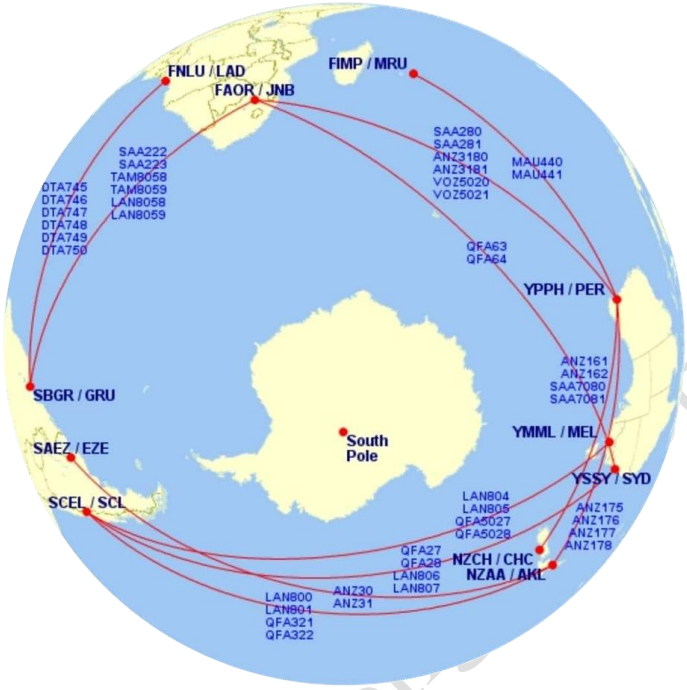
3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation into English ongoing

(#106) Direct MAU440 flight Port Louis (Mauritius) – Perth (Australia)

Direct flight from Port Louis (Mauritius) to Perth (Australia) on flight MAU440, average duration: 6 hours and 9 minutes:



The path of flight MU440 poses three problems for flattards:

1. The average flight time of 6 hours and 9 minutes is less than that on a flat Earth since the distance is greater on the latter (5,895 kilometers on a globe compared to the 12,635 kilometers on a Gleason map).

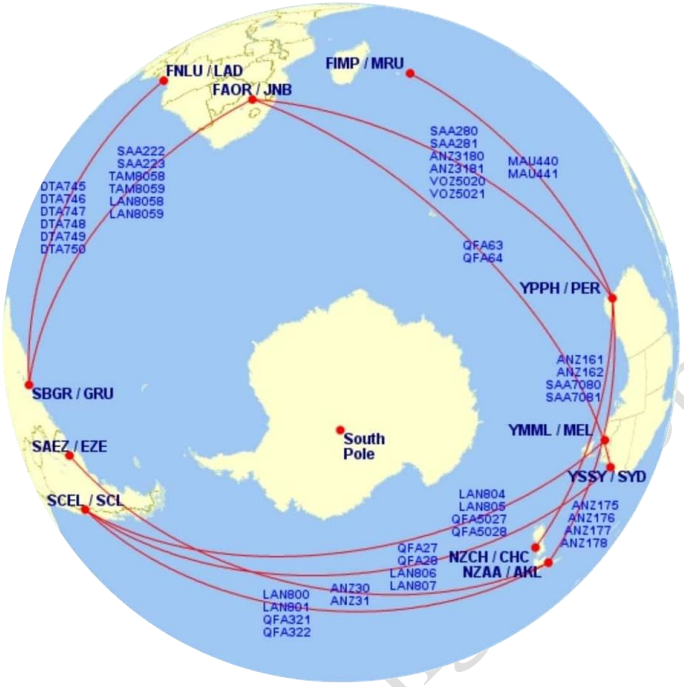
2. On a flat Earth, the flight path would cross the Northern Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.

translation into English ongoing

(#107) Direct MAU441 flight Perth (Australia) – Port Louis (Mauritius)

Direct flight from Perth (Australia) to Port Louis (Mauritius) on flight MAU441, average duration: 8 hours and 12 minutes:



The path of flight MU441 poses three problems for flattards:

1. The average flight time of 8 hours and 12 minutes is less than that on a flat Earth since the distance is greater on the latter (5,895 kilometers on a globe compared to the 12,635 kilometers on a Gleason map).

2. On a flat Earth, the flight path would cross the Northern Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.

translation into English ongoing

(#108) Direct SA280 flight Johannesburg (South Africa) – Perth (Australia)

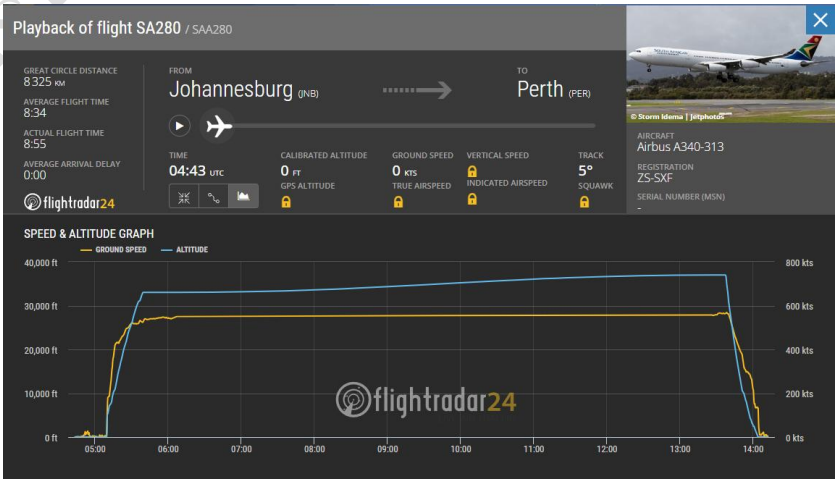
Direct flight from Johannesburg (South Africa) to Perth (Australia) on flight SA280, average duration: 8 hours and 31 minutes:

The path of flight SA280 poses three problems for flattards:

1. The average flight time of 8 hours and 34 minutes is less than that on a flat Earth since the distance is greater on the latter (8,325 kilometers on a globe compared to the 18,365 kilometers on a Gleason map).

2. On a flat Earth, the flight path would cross the Northern Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

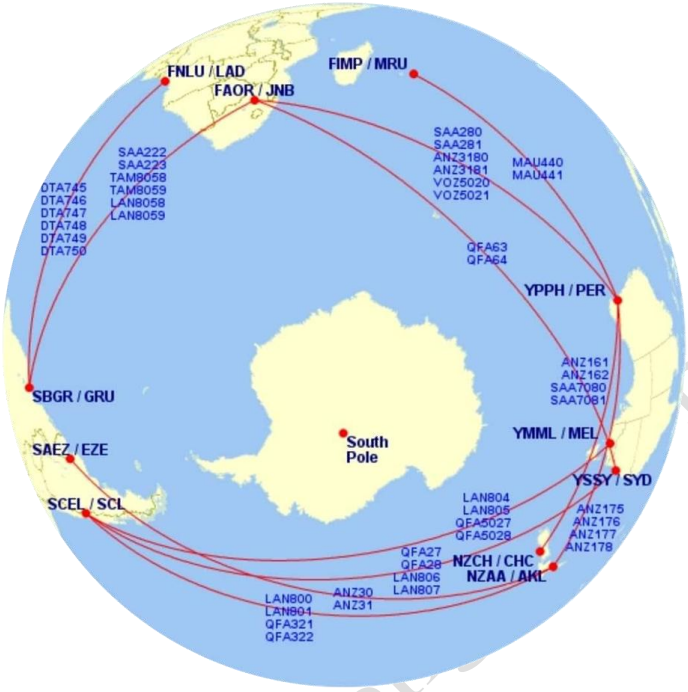
3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation in progress

(#109) Direct ANZ161 flight Auckland (New-Zealand) – Cairns (Australia)

Direct flight from Auckland (New-Zealand) to Cairns (Australia) on flight ANZ161, average duration: 5 hours:

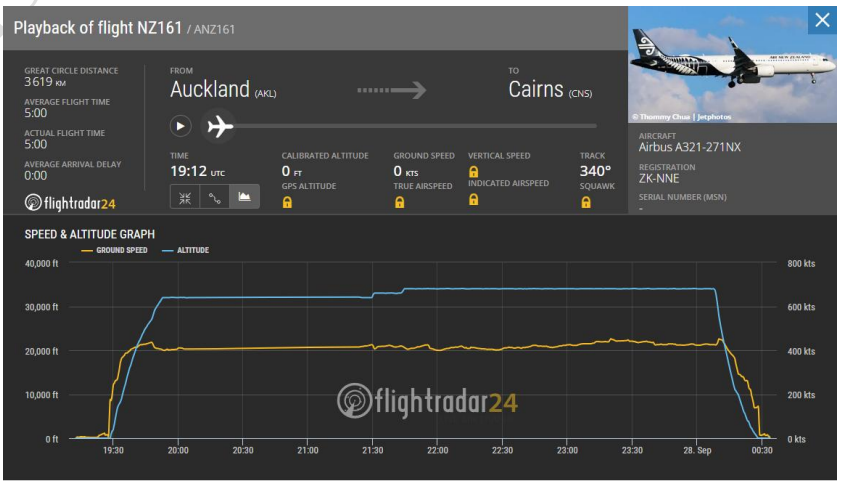


The path of flight ANZ161 poses three problems for flattards:

1. The average flight time of 5 hours is less than that on a flat Earth since the distance is greater on the latter (3,619 kilometers on a globe compared to the 6,839 kilometers on a Gleason map).

2. On a flat Earth, the flight path would cross the Northern Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

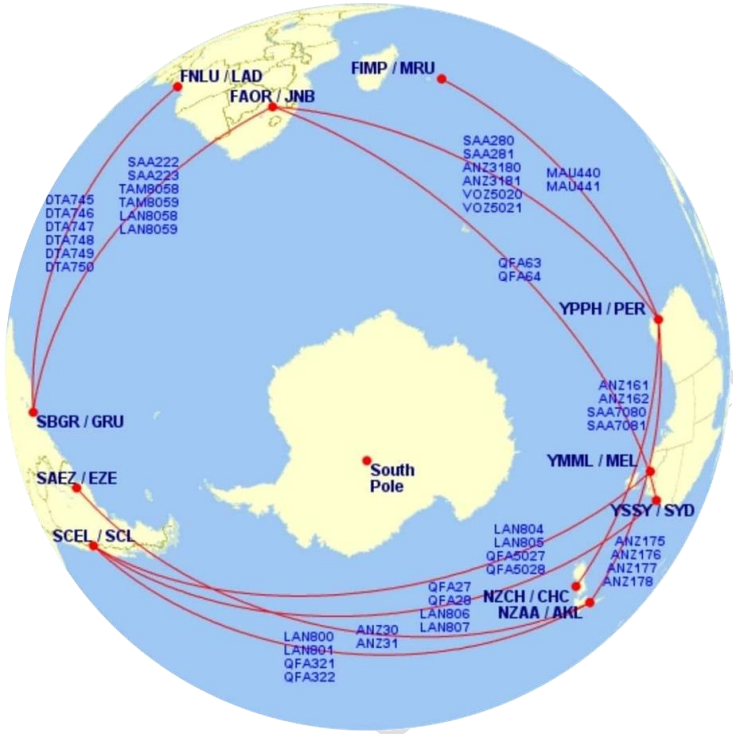
3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation into English ongoing

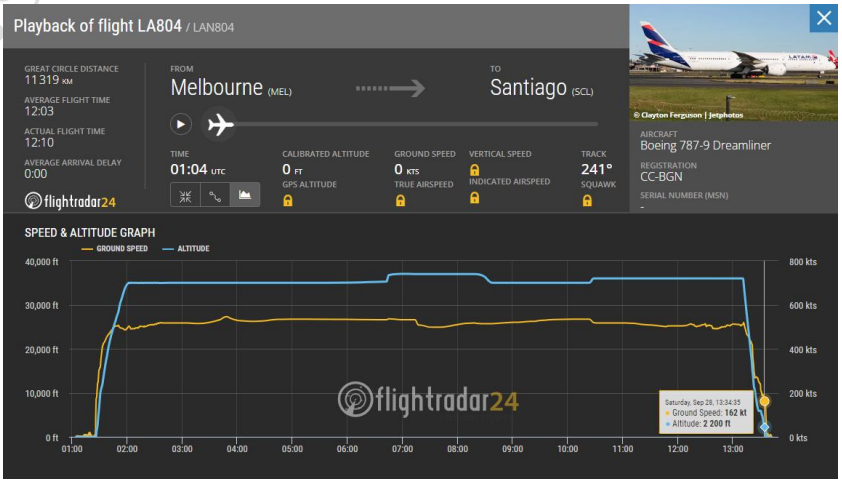
(#110) Direct LAN804 flight Melbourne (Australia) – Santiago (Chili)

Direct flight from Melbourne (Australia) to Santiago (Chili) on flight LAN804, average duration: 12 hours 3 minutes:



The path of flight LAN804 poses three problems for flattards:

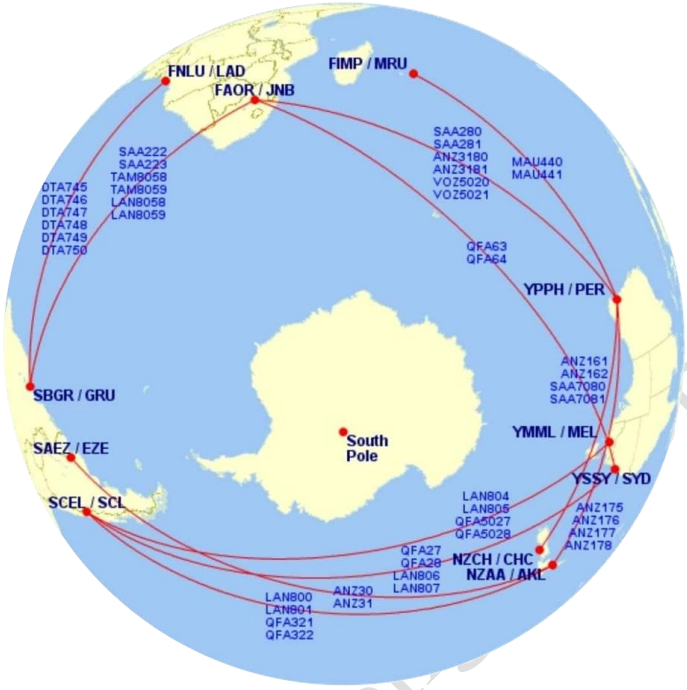
1. The average flight time of 12 hours and 3 minutes is less than that on a flat Earth since the distance is greater on the latter (11,319 kilometers on a globe compared to the 26,599 kilometers on a Gleason map).
2. Sur une Terre plate, le vol passerait par l'hémisphère Nord alors que dans la réalité il reste dans l'hémisphère Sud.
3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation ongoing

(#111) Direct LAN805 flight Santiago (Chili)– Melbourne (Australia)

Direct flight from Santiago (Chili) to Melbourne (Australia) on flight LAN805, average duration: 14 hours 9 minutes:

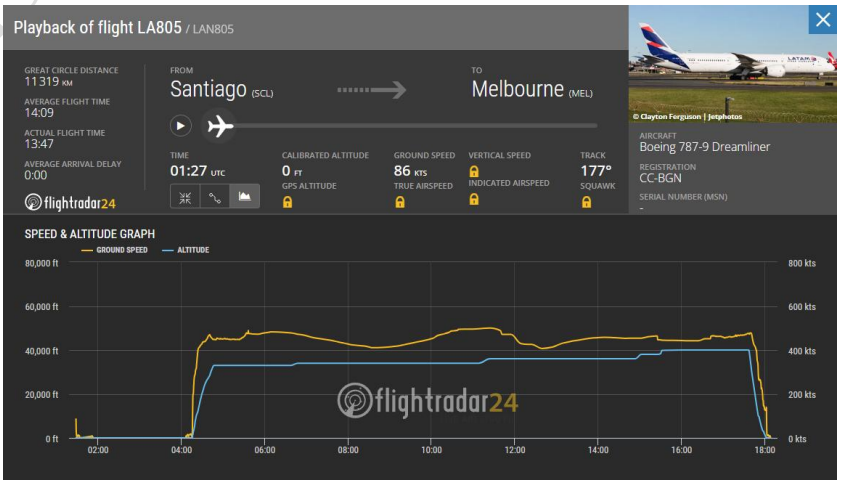


The path of flight LAN805 poses three problems for flattards:

1. The average flight time of 14 hours and 9 minutes is less than that on a flat Earth since the distance is greater on the latter (11,319 kilometers on a globe compared to the 26,599 kilometers on a Gleason map).

2. Sur une Terre plate, le vol passerait par l'hémisphère Nord alors que dans la réalité il reste dans l'hémisphère Sud.

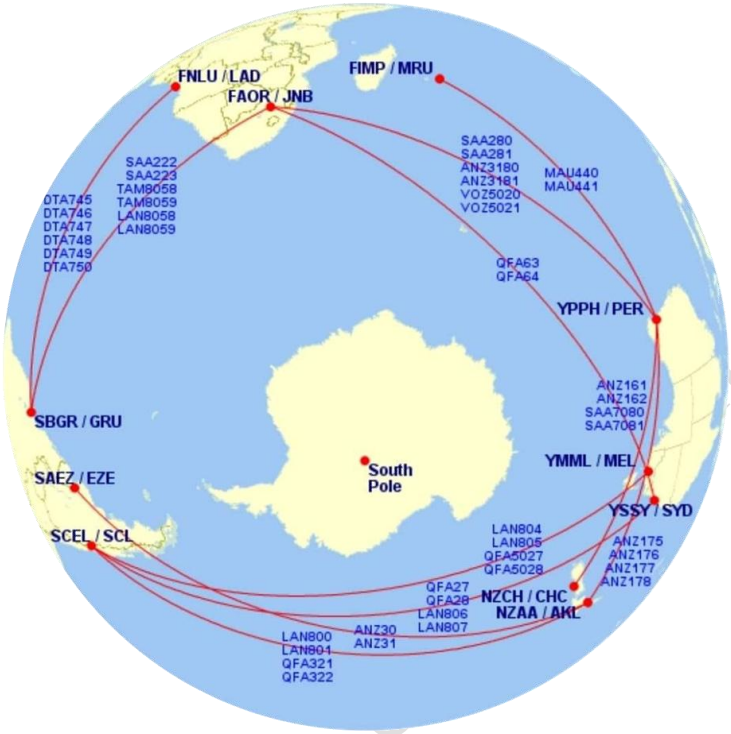
3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation into English ongoing

(#112) Direct DTA747 flight Luanda (Angola) – Sao Paulo (Brazil)

Direct flight from Santiago (Chili) to Melbourne (Australia) on flight LAN805, average duration: 8 hours:



The path of flight DTA747 poses three problems for flattards:

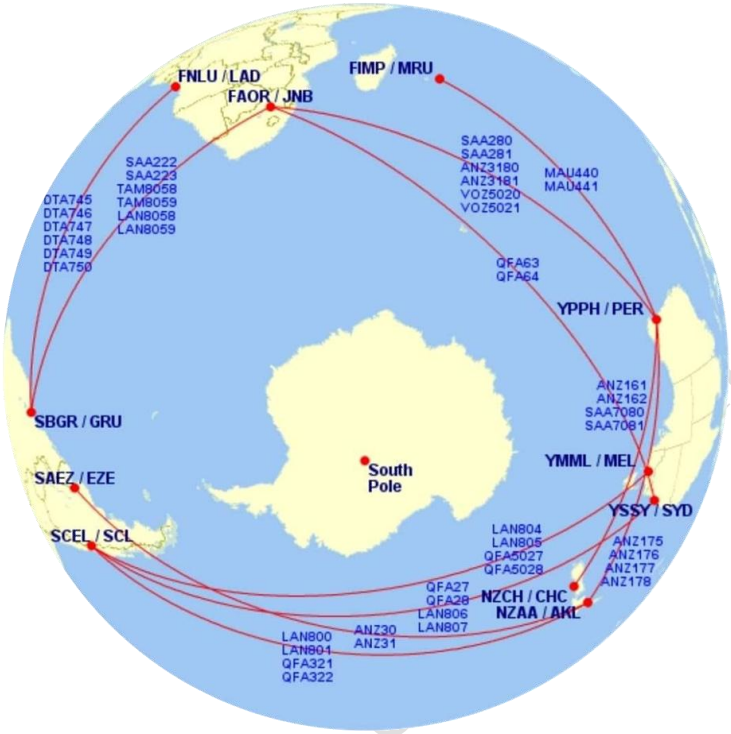
1. The average flight time of 8 hours is less than that on a flat Earth since the distance is greater on the latter (6,541 kilometers on a globe compared to the 11,865 kilometers on a Gleason map).

2. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.

translation into English ongoing

(#113) Direct DTA748 flight Sao Paulo (Brazil) – Luanda (Angola)

Direct flight from Sao Paulo (Brazil) to Luanda (Angola) on flight DTA748, average duration: 7 hours 18 minutes:



The path of flight DTA748 poses two problems for flattards:

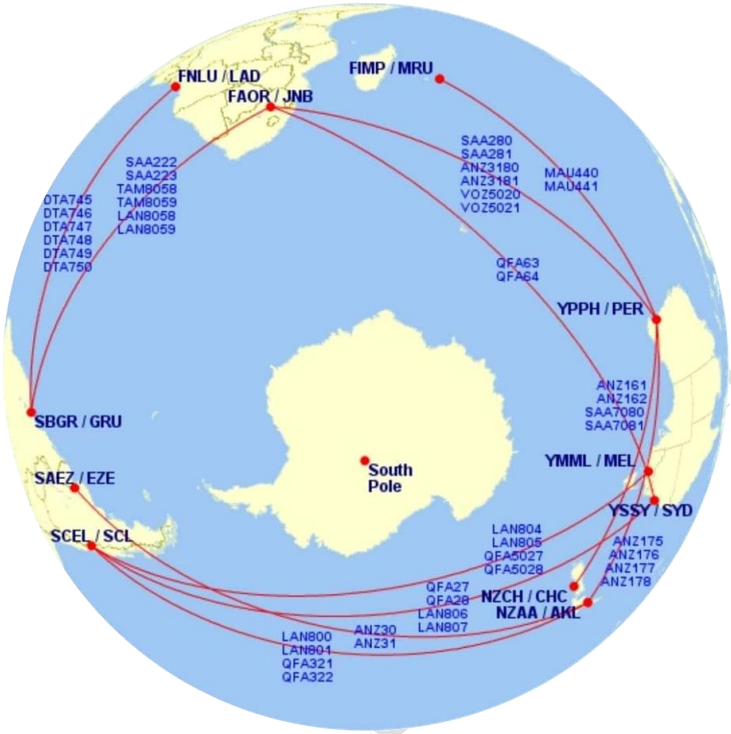
1. The average flight time of 7 hours and 18 minutes is less than that on a flat Earth since the distance is greater on the latter (6,541 kilometers on a globe compared to the 11,865 kilometers on a Gleason map).

2. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.

translation into English ongoing

(#114) Direct SA222 flight Johannesburg (South Africa) – Sao Paulo (Brazil)

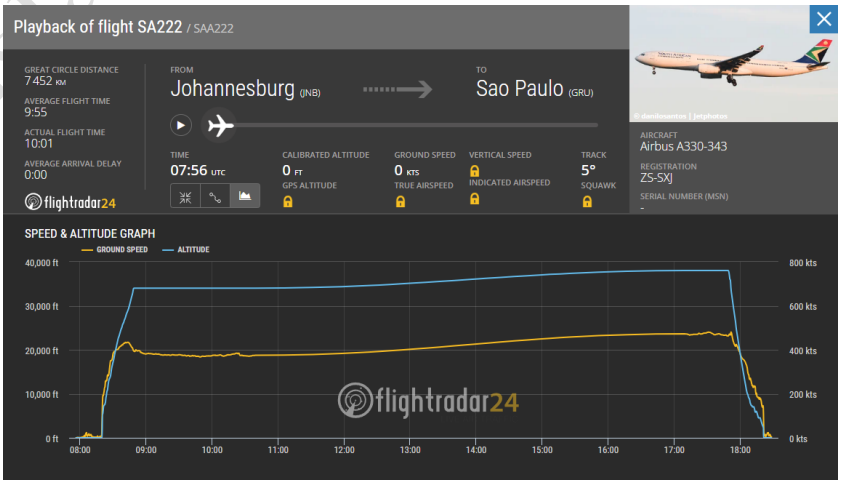
Direct flight from Johannesburg (South Africa) to Sao Paulo (Brazil) on flight SA222, average duration: 9 hours 55 minutes:



The path of flight SA222 poses two problems for flattards:

1. The average flight time of 9 hours and 5 minutes is less than that on a flat Earth since the distance is greater on the latter (7,452 kilometers on a globe compared to the 15,494 kilometers on a Gleason map).

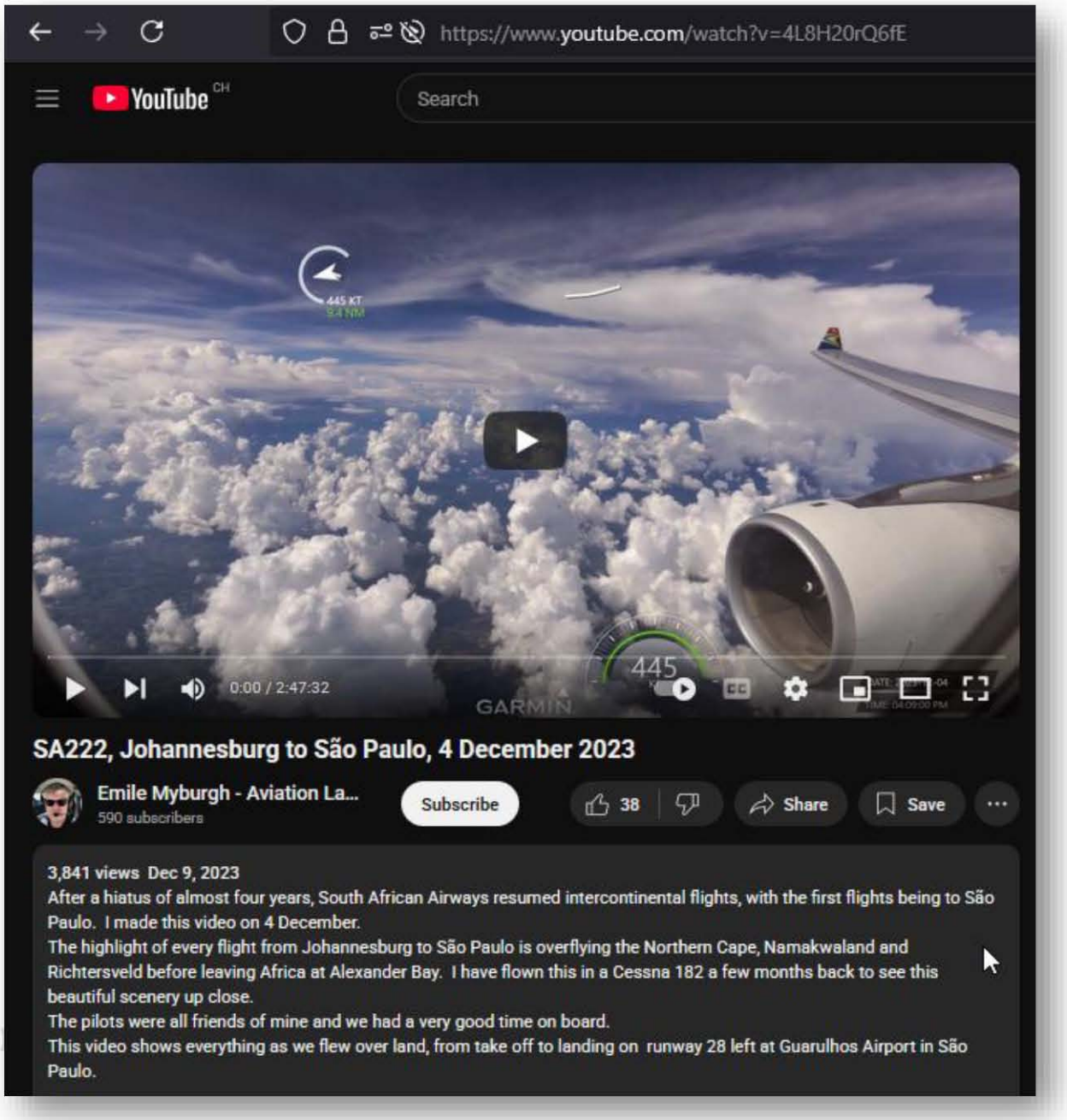
2. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation into English ongoing

The flat Earth liars and manipulators claim that this flight does not exist and that there is no video evidence that this flight exists but... unfortunately for them there are videos and here is one:

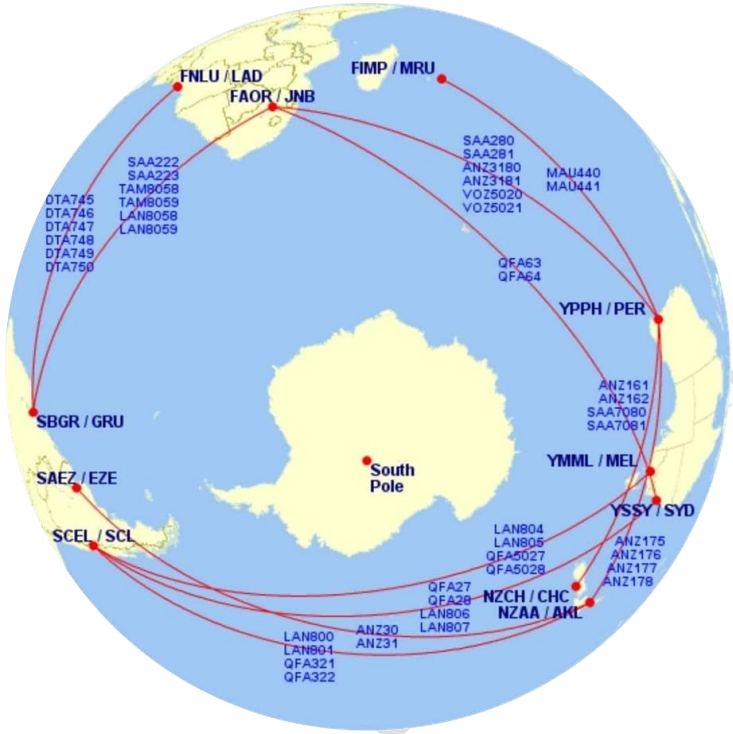
https://www.youtube.com/watch?v=4L8H20rQ6fE


https://www.youtube.com/watch?v=4L8H20rQ6fE
YouTube CH
Search
445 KT
0:00 / 2:47:32
GARMIN
445
SA222, Johannesburg to São Paulo, 4 December 2023
Emile Myburgh - Aviation La...
590 subscribers
Subscribe
38
Share
Save
3,841 views Dec 9, 2023
After a hiatus of almost four years, South African Airways resumed intercontinental flights, with the first flights being to São Paulo. I made this video on 4 December.
The highlight of every flight from Johannesburg to São Paulo is overflying the Northern Cape, Namakwaland and Richtersveld before leaving Africa at Alexander Bay. I have flown this in a Cessna 182 a few months back to see this beautiful scenery up close.
The pilots were all friends of mine and we had a very good time on board.
This video shows everything as we flew over land, from take off to landing on runway 28 left at Guarulhos Airport in São Paulo.

On his YouTube channel there is also the video of the flight from Cape Town to Sao Paulo...

(#115) Direct SA223 flight Sao Paulo (Brazil) - Johannesburg (South Africa)

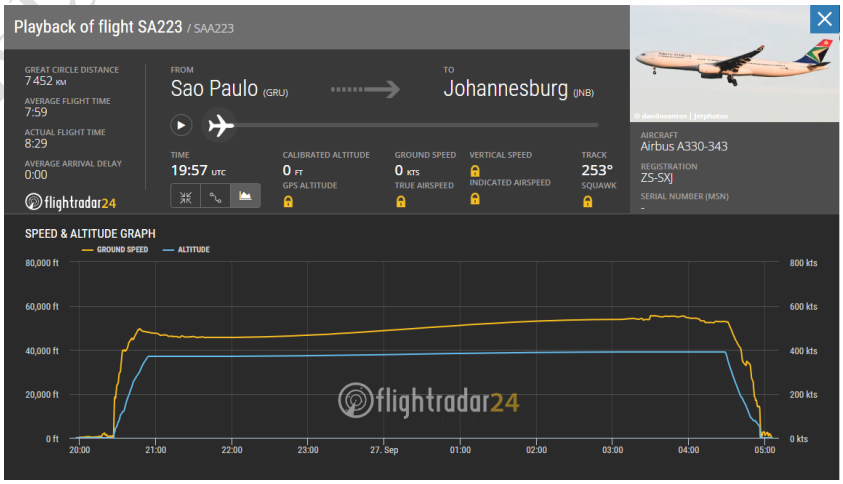
Direct flight from Sao Paulo (Brazil) to Johannesburg (South Africa) on flight SA223, average duration: 7 hours 59 minutes:



The path of flight SA223 poses two problems for flattards:

1. The average flight time of 7 hours and 59 minutes is less than that on a flat Earth since the distance is greater on the latter (7,452 kilometers on a globe compared to the 15,494 kilometers on a Gleason map).

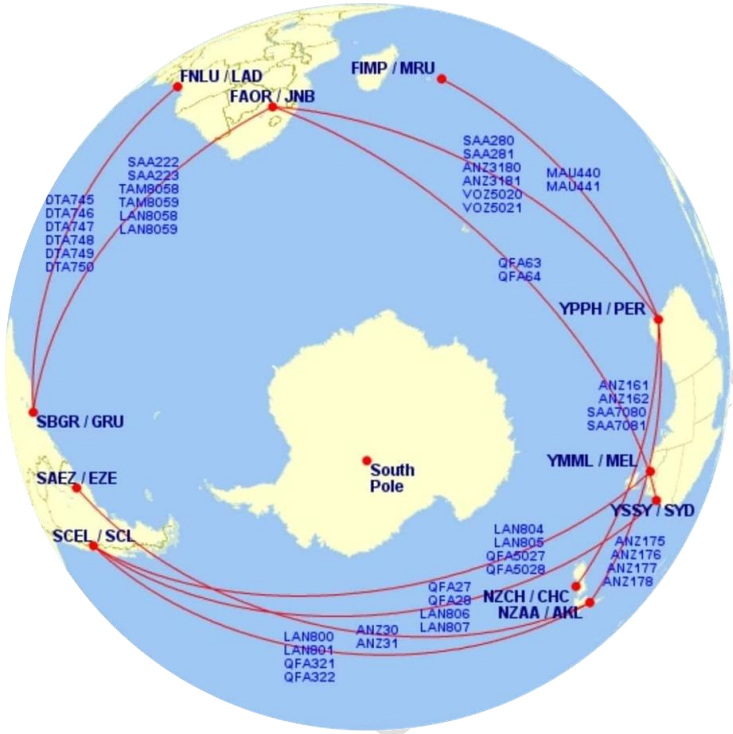
2. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation into English ongoing

(#116) Direct TAM8058 flight Sao Paulo (Brazil) - Johannesburg (South Africa)

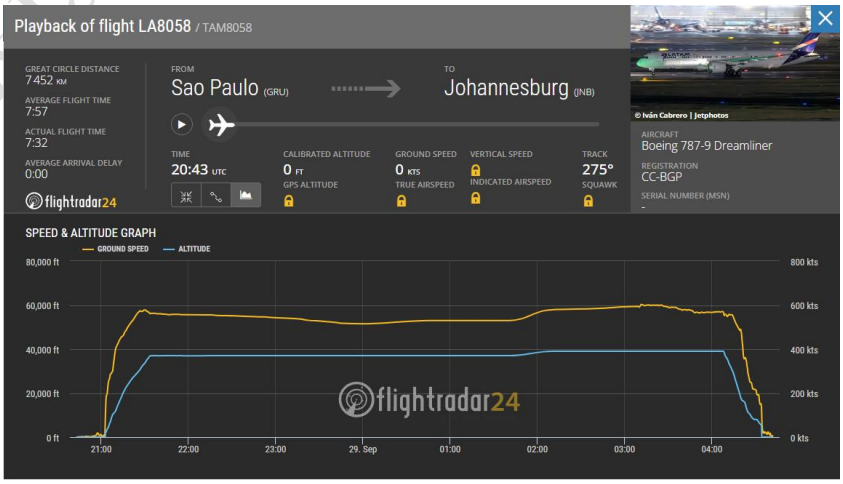
Direct flight from Sao Paulo (Brazil) to Johannesburg (South Africa) on flight TAM8058, average duration: 7 hours 57 minutes:



The path of flight TAM8058 poses two problems for flattards:

1. The average flight time of 7 hours and 59 minutes is less than that on a flat Earth since the distance is greater on the latter (7,452 kilometers on a globe compared to the 15,494 kilometers on a Gleason map).

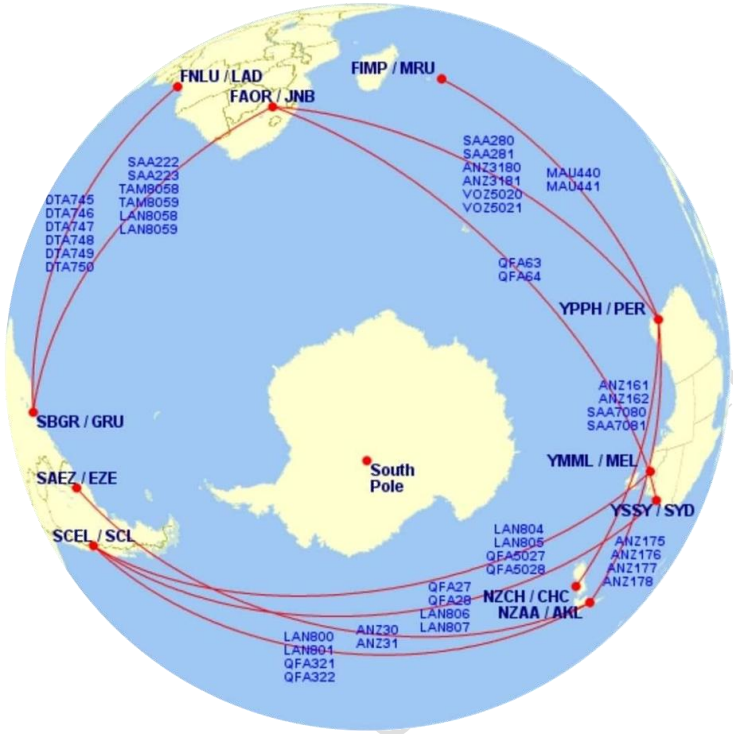
2. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation into English ongoing

(#117) Direct TAM8059 flight Johannesburg (South Africa) - Sao Paulo (Brazil)

Direct flight from Johannesburg (South Africa) to Sao Paulo (Brazil) on flight TAM8059, average duration: 9 hours 23 minutes:



The path of flight TAM8059 poses two problems for flattards:

1. The average flight time of 9 hours and 53 minutes is less than that on a flat Earth since the distance is greater on the latter (7,452 kilometers on a globe compared to the 15,494 kilometers on a Gleason map).

2. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.

translation into English ongoing

(#118) Direct LAN800 flight Auckland (Australia) - Santiago (Chili)

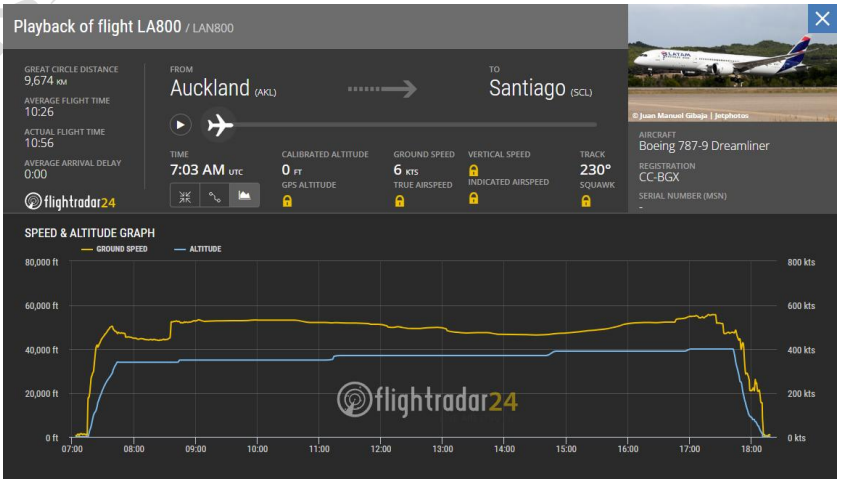
Direct flight from Auckland (Australia) to Santiago (Chili) on flight LAN800, average duration: 10 hours and 26 minutes:

The path of flight LAN800 poses three problems for flattards:

1. The average flight time of 10 hours and 26 minutes is less than that on a flat Earth since the distance is greater on the latter (9 674 kilometers on a globe compared to the 23 405 kilometers on a Gleason map).

2. On a flat Earth, the flight path would cross the Northern Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

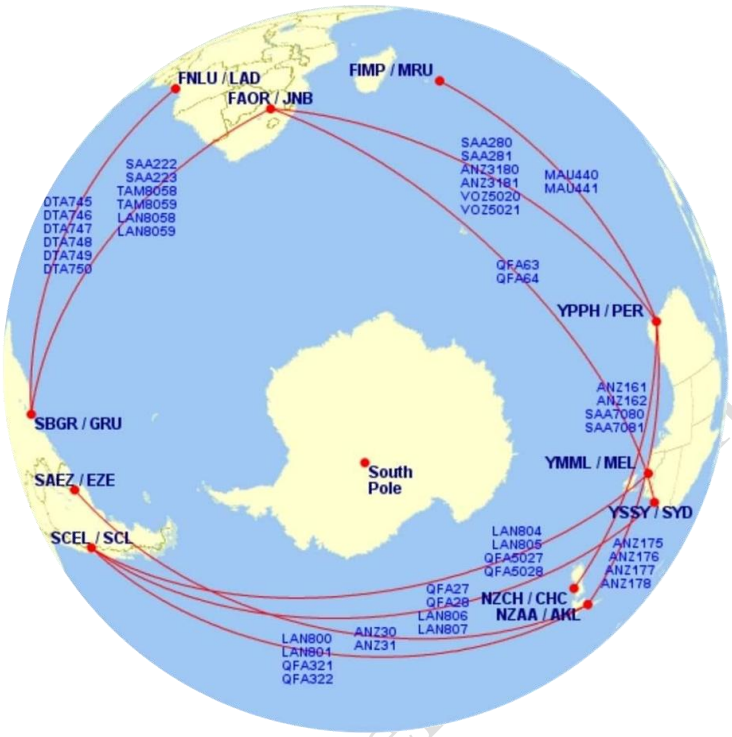
3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation in progress

(#119) Direct LAN801 flight Santiago (Chili) - Auckland (Australia)

Direct flight from Santiago (Chili) to Auckland (Australia) on flight LAN801, average duration: 11 hours and 58 minutes:

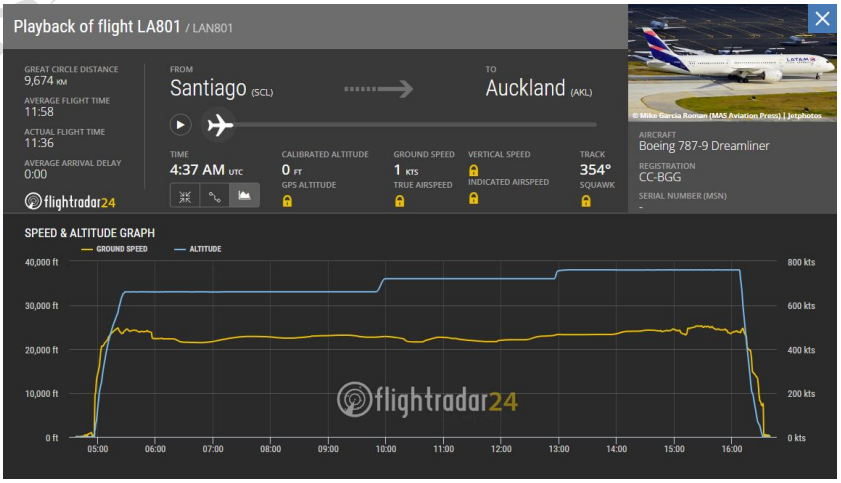


The path of flight LAN801 poses three problems for flattards:

1. The average flight time of 11 hours and 58 minutes is less than that on a flat Earth since the distance is greater on the latter (9 674 kilometers on a globe compared to the 23 405 kilometers on a Gleason map).

2. On a flat Earth, the flight path would cross the Northern Hemisphere, whereas in reality it remains entirely within the Southern Hemisphere.

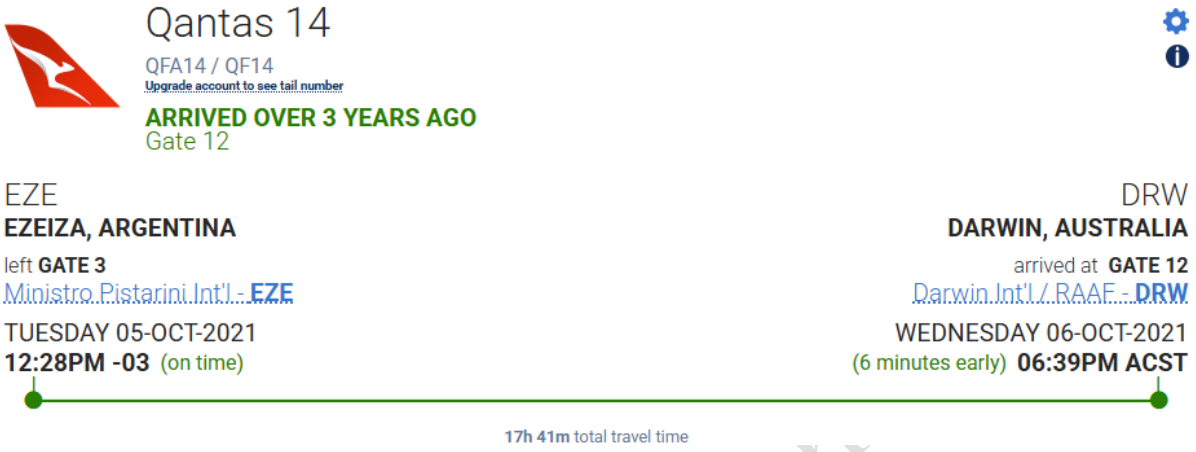
3. The trajectories are not straight lines projected onto a plane (loxodromes) but arcs of great circles (orthodromies) in accordance with what we would have on a globe.



translation into English ongoing

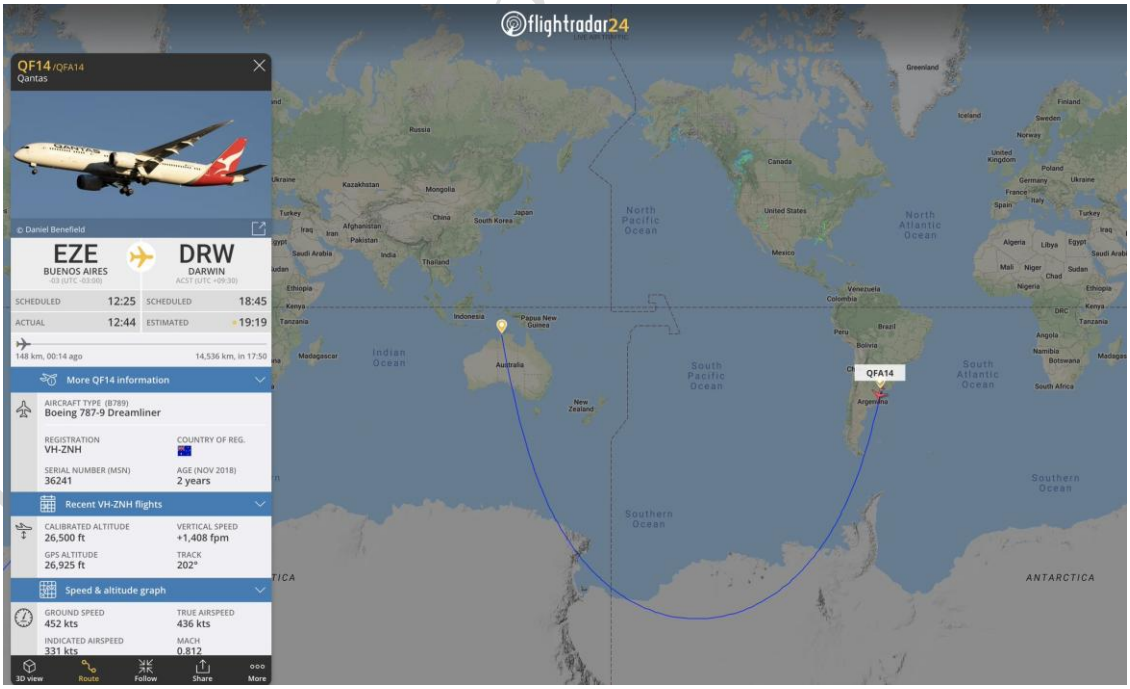
(#120) Test flight QFA14 Buenos Aires (Argentina) – Darwin (Australia)

This direct test flight of over 14,880 km lasted 17 hours and 50 minutes, with an average speed of 827.3 km/h. The flight departed south, flew over Antarctica, and arrived in Darwin from the south. The entire flight was tracked and recorded on flightradar24.



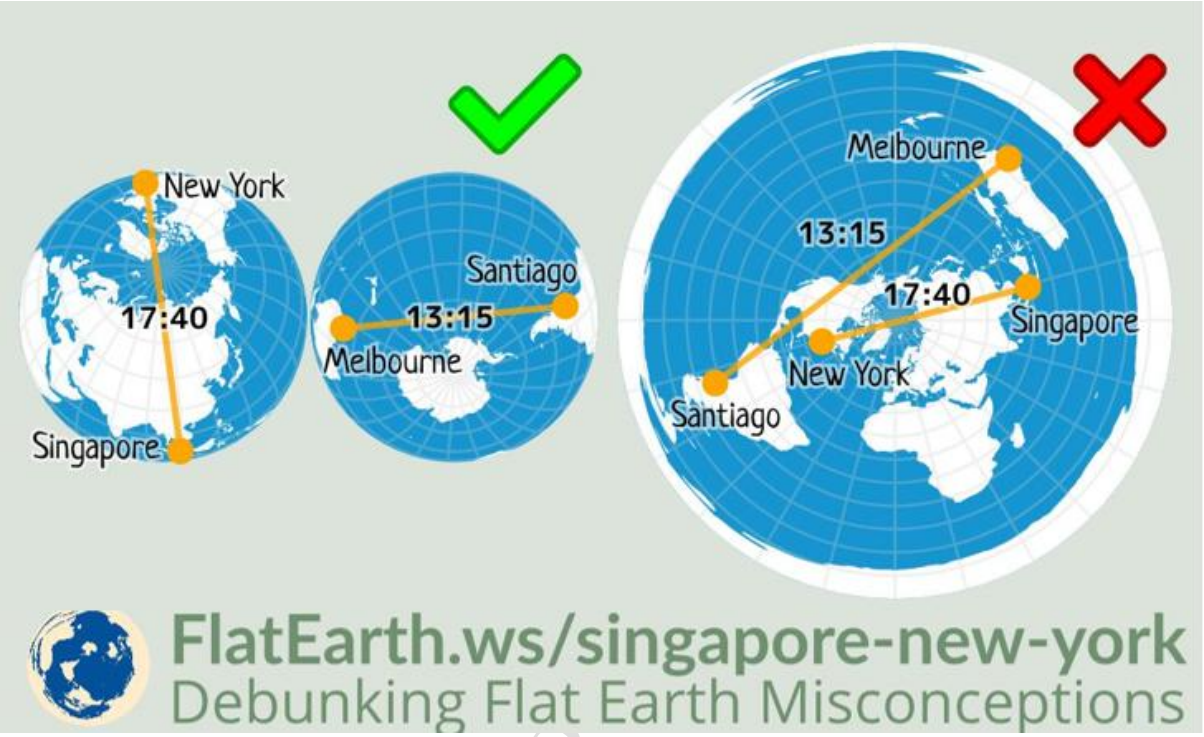
On a flat Earth, using the Gleason map, the shortest distance would be via the North Pole, an unattainable 25,140 km, and would take 30 hours and 37 minutes of flight at a speed of 833.3 km/h.

Note: 30 hours and 37 minutes is a relatively slow speed. The flight was accompanied by an average headwind of 92.6 km/h, which gives a top speed of 926 km/h.



(#121) Longest flight path and consistency

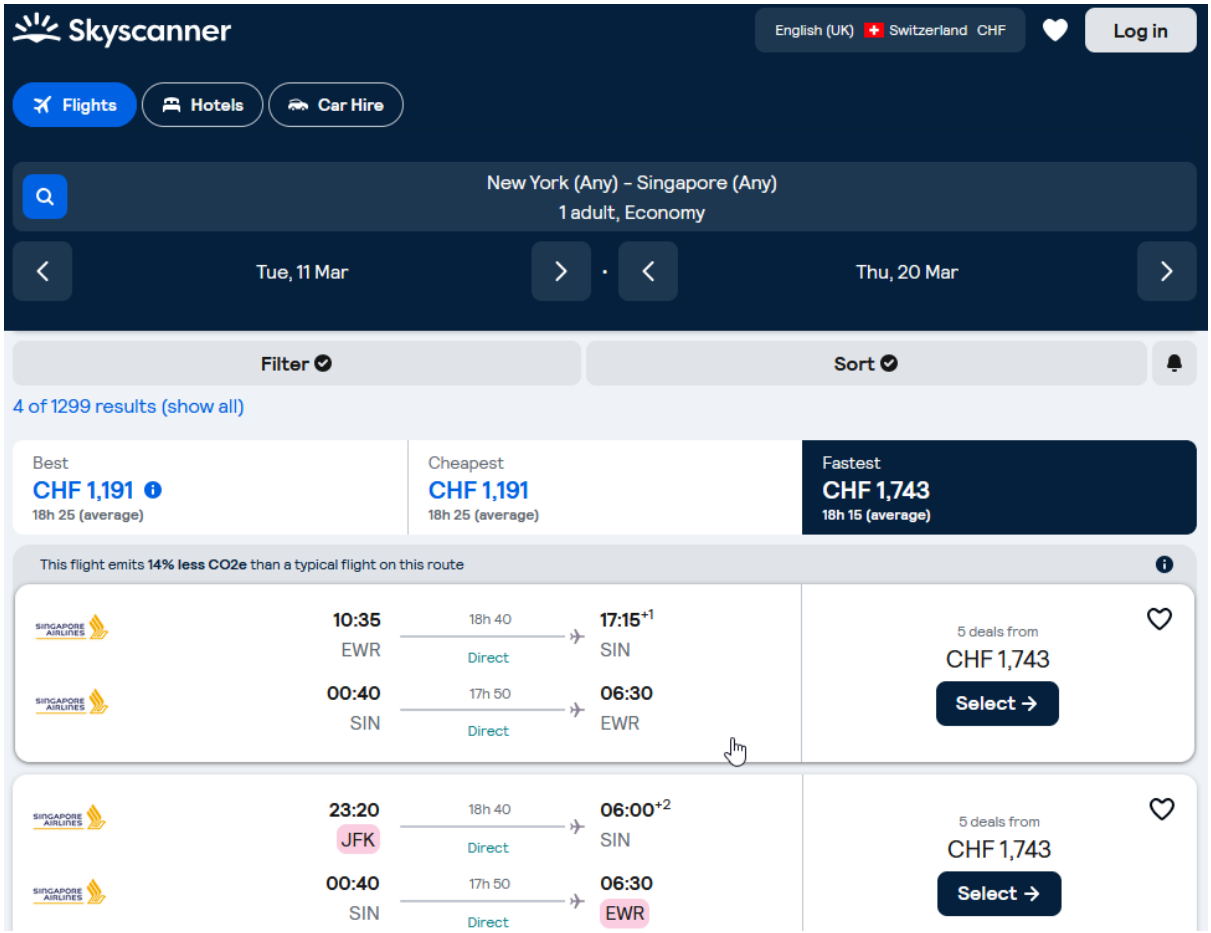
As of 2020, the **Singapore-New York flight route is the longest** (15,330 km on the globe), while the **Melbourne-Santiago route is the southernmost** (11,269 km on the globe). The actual durations of these routes are only consistent if the Earth is a sphere.



On a flat Earth, the journey from Melbourne to Santiago would take longer than the journey from Singapore to New York. The actual duration of these journeys contradicts the flat Earth model.

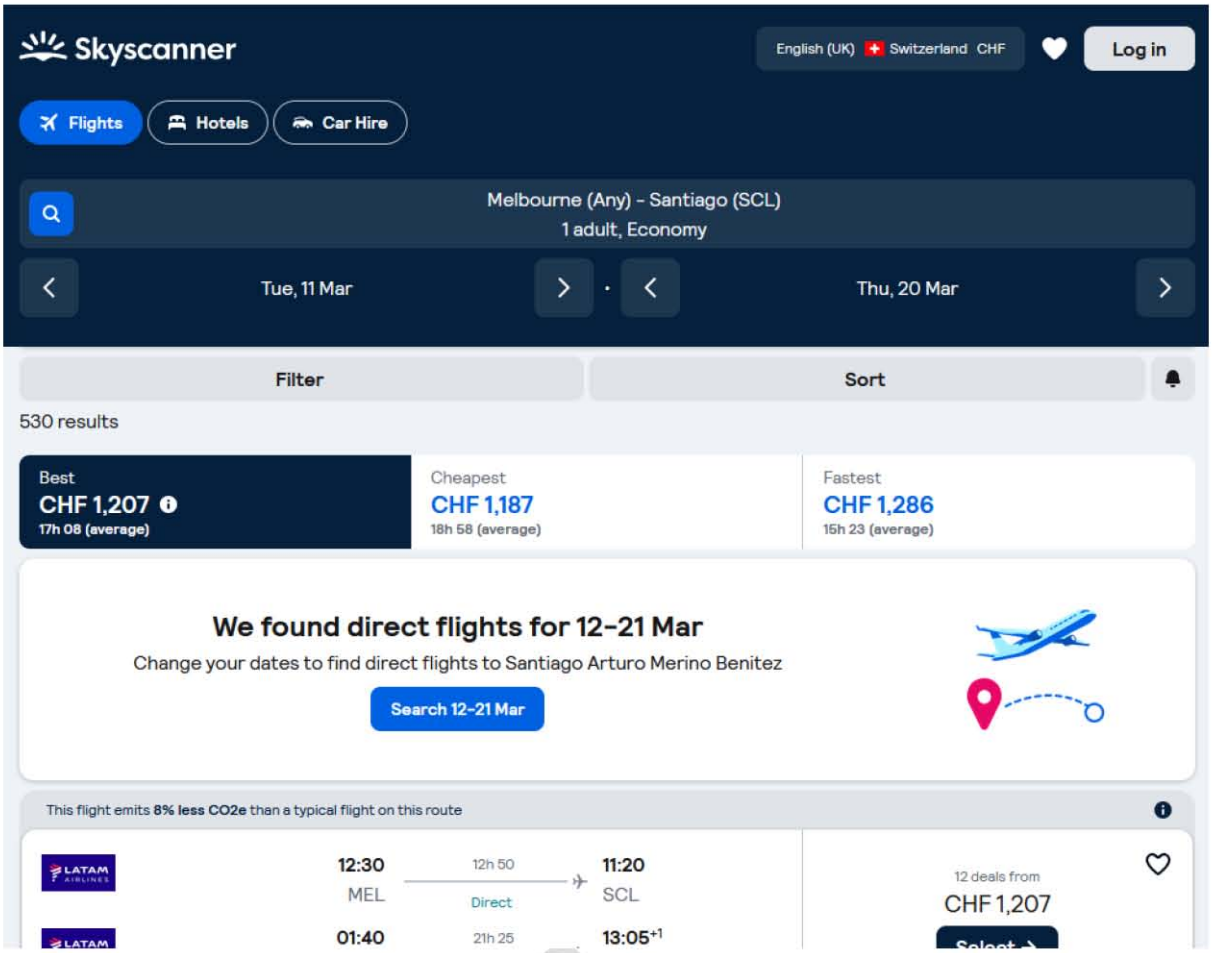
We can check this on SkyScanner (www.skyscanner.com) for example for the New York-Singapore flight:

translation into



And for the Melbourne-Santiago flight:

translation into



translation into

(#122) Aircraft nose tilt

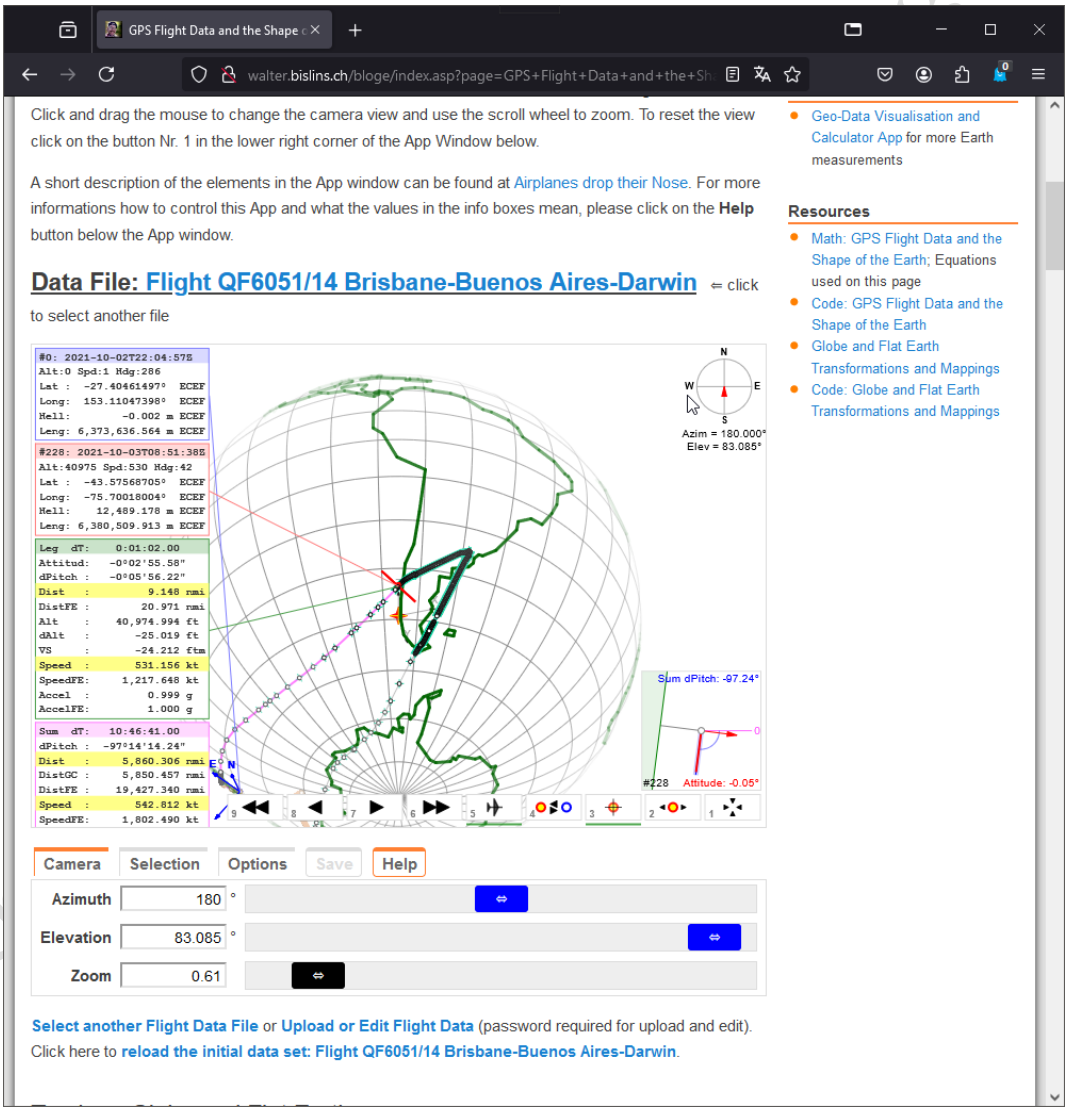
GPS flight data proves that the Earth is not flat. Indeed, GPS data shows that airplanes tilt their noses 1° every 111.2 km. Assuming GPS data is recorded on a flat Earth, we get speeds and accelerations that are impossible over Antarctica. The GPS Flight Data Visualization app can be used to analyze GPS flight data.

Raw flight data from several dozen flights are available here:

http://walter.bislins.ch/bloge/index.asp?page=Select+Flight+Data

The interactive page for what we will present below is available here:

http://walter.bislins.ch/bloge/index.asp?page=GPS+Flight+Data+and+the+Shape+of+the+Earth


GPS Flight Data and the Shape
walter.bislins.ch/bloge/index.asp?page=GPS+Flight+Data+and+the+Sh
Click and drag the mouse to change the camera view and use the scroll wheel to zoom. To reset the view click on the button Nr. 1 in the lower right corner of the App Window below.
A short description of the elements in the App window can be found at Airplanes drop their Nose. For more informations how to control this App and what the values in the info boxes mean, please click on the Help button below the App window.
Data File: Flight QF6051/14 Brisbane-Buenos Aires-Darwin ⇐ click to select another file
Geo-Data Visualisation and Calculator App for more Earth measurements
Resources
Math: GPS Flight Data and the Shape of the Earth; Equations used on this page
Code: GPS Flight Data and the Shape of the Earth
Globe and Flat Earth Transformations and Mappings
Code: Globe and Flat Earth Transformations and Mappings
Azim = 180.000°
Elev = 83.085°
Sum dPitch: -97.24°
#228 Attitude: -0.05°
Camera
Selection
Options
Save
Help
Azimuth 180 °
Elevation 83.085 °
Zoom 0.61
Select another Flight Data File or Upload or Edit Flight Data (password required for upload and edit).
Click here to reload the initial data set: Flight QF6051/14 Brisbane-Buenos Aires-Darwin.

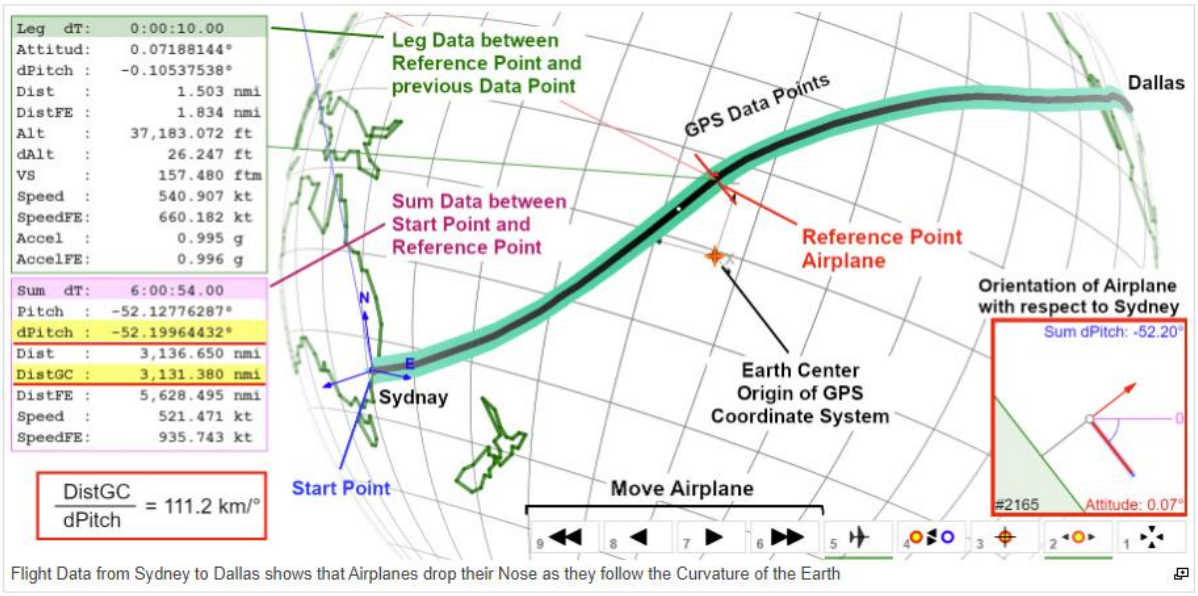
In the table below is the data of each Data Point listed, displayed in the App above. The raw position data is given in Earth Centered Earth Fixed (ECEF) cartesian coordinates in the **X, Y, Z** columns in meters. In the column **Time** is the time stamp of each data point listed in UTC time. In the column **|X,Y,Z|** is the length of each (X,Y,Z) vector listed, which is the radius of

the Earth at the location of the data point plus its altitude. If there is additional flight data available, it is listed in the column **Additional Data**:

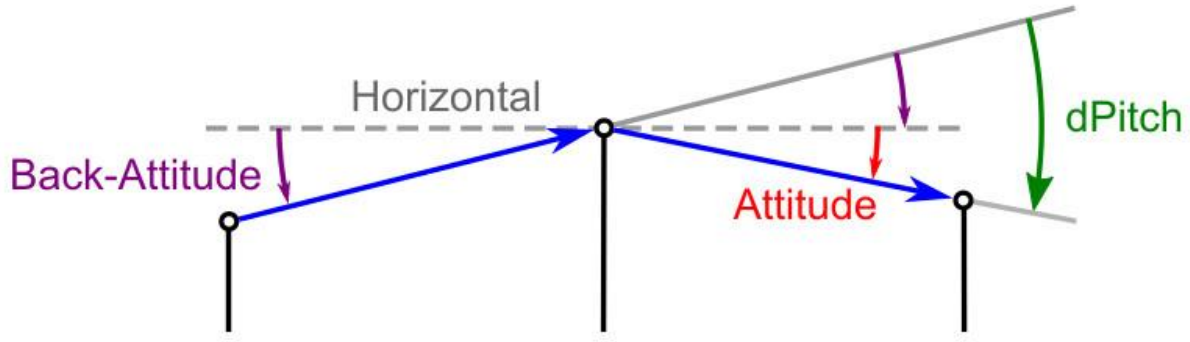
Nr	Time	X	Y	Z	|X,Y,Z|	Additional Data
0	2021-10-02 22:04:57	-5,053,742.230	2,562,748.240	-2,918,090.810	6,373,636.564	Alt:0 Spd:1 Hdg:286
1	2021-10-02 22:09:44	-5,053,748.200	2,562,725.870	-2,918,100.060	6,373,636.538	Alt:0 Spd:2 Hdg:286
2	2021-10-02 22:10:10	-5,053,754.800	2,562,697.170	-2,918,113.730	6,373,636.490	Alt:0 Spd:11 Hdg:295
3	2021-10-02 22:10:24	-5,053,760.100	2,562,676.130	-2,918,122.980	6,373,636.468	Alt:0 Spd:10 Hdg:312
4	2021-10-02 22:10:50	-5,053,761.210	2,562,652.960	-2,918,141.280	6,373,636.410	Alt:0 Spd:2 Hdg:351
5	2021-10-02 22:11:57	-5,053,774.110	2,562,651.080	-2,918,120.720	6,373,636.470	Alt:0 Spd:9 Hdg:5
6	2021-10-02 22:12:43	-5,053,758.900	2,562,653.570	-2,918,144.720	6,373,636.399	Alt:0 Spd:11 Hdg:22
7	2021-10-02 22:13:03	-5,053,739.620	2,562,664.080	-2,918,168.730	6,373,636.330	Alt:0 Spd:11 Hdg:25
8	2021-10-02 22:13:24	-5,053,720.330	2,562,674.590	-2,918,192.730	6,373,636.249	Alt:0 Spd:11 Hdg:22
9	2021-10-02 22:13:42	-5,053,703.260	2,562,684.570	-2,918,213.390	6,373,636.186	Alt:0 Spd:11 Hdg:28
10	2021-10-02 22:17:14	-5,053,720.640	2,562,673.090	-2,918,193.520	6,373,636.254	Alt:0 Spd:11 Hdg:25
11	2021-10-02 22:17:30	-5,053,741.510	2,562,656.500	-2,918,172.070	6,373,636.310	Alt:0 Spd:15 Hdg:36

Figure 67 Flight data QF6051/14 Brisbane-Buenos Aires-Darwin

The **Attitude** angle is the vertical angle, measured between the horizontal plane at a data point and the line of sight to the next data point. On a Flat Earth this angle is zero if the current data point and the next data point are at the same elevation. On the Globe Earth however, even if the elevation of the next data point is the same, the next data point drops below the horizontal plane of the current point, due to Earths' cuvature


Leg dT: 0:00:10.00
Attitud: 0.07188144°
dPitch : -0.10537538°
Dist : 1.503 nmi
DistFE : 1.834 nmi
Alt : 37,183.072 ft
dAlt : 26.247 ft
VS : 157.480 ftm
Speed : 540.907 kt
SpeedFE: 660.182 kt
Accel : 0.995 g
AccelFE: 0.996 g
Sum dT: 6:00:54.00
Pitch : -52.12776287°
dPitch : -52.19964432°
Dist : 3,136.650 nmi
DistGC : 3,131.380 nmi
DistFE : 5,628.495 nmi
Speed : 521.471 kt
SpeedFE: 935.743 kt
DistGC / dPitch = 111.2 km/°
Leg Data between Reference Point and previous Data Point
GPS Data Points
Dallas
Sum Data between Start Point and Reference Point
Reference Point Airplane
Orientation of Airplane with respect to Sydney
Sum dPitch: -52.20°
Earth Center Origin of GPS Coordinate System
Sydnay
Start Point
Move Airplane
#2165
Attitude: 0.07°
Flight Data from Sydney to Dallas shows that Airplanes drop their Nose as they follow the Curvature of the Earth

The connection between any two Data Points build a 3D vector, as depictied by the blue arrows in the figure. So we can use vector algebra to calculate the vertical angle between each vector and the horizontal plane at a Data Point, named the "Attidude Angle".



If we have the Attitude angles of a Data Point to the previous and next Data Point we can calculate how much the airplane droped the nose at that point. In the App this change is labeled *dPitch* (for delta Pitch). It is the sum of the Attitude angle to the previous data point plus the Attitude angle to the next data point. This delta pitch is displayed in the green *Leg Info Box* at *dPitch*. A negative value means that the airplane has droped the nose between the previous and the next data point accordingly.

We can sum all pitch changes dPitch between Start Point and Reference Point to calculate, how much the airplane dropped the nose between these points.

- On the Flat Earth, the sum of dPitch over long distances would be zero
- On the globe Earth, the sum of dPitch should be −1° per 111.2 km

What is the pitch rate calculated from the data in the example above?

We have :

$$\text{Pitch rate} = \frac{d\text{Pitch}}{GC\text{Dist}} = \frac{-52.20°}{5799.32\ [\text{km}]} = \frac{-1°}{111.1\ [\text{km}]}$$

Where we have :

- *Pitch rate* : the rate the airplane dropes the nose
- *d*Pitch : On the globe Earth, the sum of dPitch should be −1° per 111.2 km
- *GC*Dist : great circle distance between Start Point and Reference Point (3131.38 nmi = 5799.32 km)

The sum of all dPitch values between *Start Point* and *Reference Point* is displayed in the magenta *Sum Info Box* at the yellow highlighted *dPitch* field. It is also shown in the small window at the lower right corner of the App window in blue. The great circle distance between *Start Point* and *Reference Point* is displayed in the *Sum Info Box* at *DistGC*.

It turns out that the sum of all dPitch values, in the example -52.20°, is not zero as required by the Flat Earth model. The calculated PitchRate of -1° per 111.1 km is very close to the expected -1° per 111.195 km of the globe model. Because the relation above is for a sphere, not an ellipsoid, there is this small difference. The value displayed in the App is more accurate for the flown track, because it is measured from real data.

translation into english ongoing

Most positions come from aircraft's GPS based ADS-B transmission, but Flightradar24 also uses positions calculated by multilateration (MLAT) and, when coverage is lost, estimated positions.

For ADS-B, the aircraft's *NACp* value provides a useful accuracy category. NACp 9 means an estimated horizontal position error below 30 [m] with 95% cumulated probability. That is a category threshold, not a measured standard deviation for all Flightradar24 positions.

If you need a standard deviation for a calculation, assume independent, equally distributed Gaussian errors in the east and north coordinates. Under that assumption, a 30 m radius containing 95% of positions corresponds to $\sigma \approx 12.3$ [m] per coordinate. This converts the NACp 9 threshold into a model parameter; it is not a standard deviation published by Flightradar24. An estimated map position may have a substantially different error.

If we wish to conduct a scientific analysis of the result, we must employ the standard scientific method known as NHST (Null Hypothesis Statistical Testing) - specifically, in the case above, a two-tailed *Z*-test:

$$\bar{x} - \frac{\sigma}{\sqrt{n}} \leq \mu \leq \bar{x} + \frac{\sigma}{\sqrt{n}}$$

However, we know the σ of each GPS component, but not that of the pitch angle calculation provided for each pair of GPS coordinates given by:

Or, nous connaissons le σ de chaque composante G.P.S. mais pas celui du calcul de l'angle de tangage donné pour chaque couple de coordonnés G.P.S. par :

$$\varphi_i = \cos^{-1}\left(\frac{\vec{z}_i \circ (\vec{P}_{i+1} - \vec{P}_i)}{|\vec{z}_i| \cdot |\vec{P}_{i+1} - \vec{P}_i|}\right)$$

However, calculating the propagation of the standard deviation for something of this kind is very tedious. So using instead a Monte Carlo simulation - typically in a simple spreadsheet with 1,144 rows (the number of rows corresponding to the number of GPS coordinates) - we get:

$$\sigma_\varphi \cong 0.63$$

And with this NHST test we have $H_0: \mu_\varphi = 0$, $H_A: \mu_\varphi \neq 0$. Hence :

$$Z = \frac{\mu_\varphi - \bar{x}_\varphi}{\sigma_\varphi / n} = \frac{0 - 1.1^\circ}{0.63 / 1144} \cong 59$$

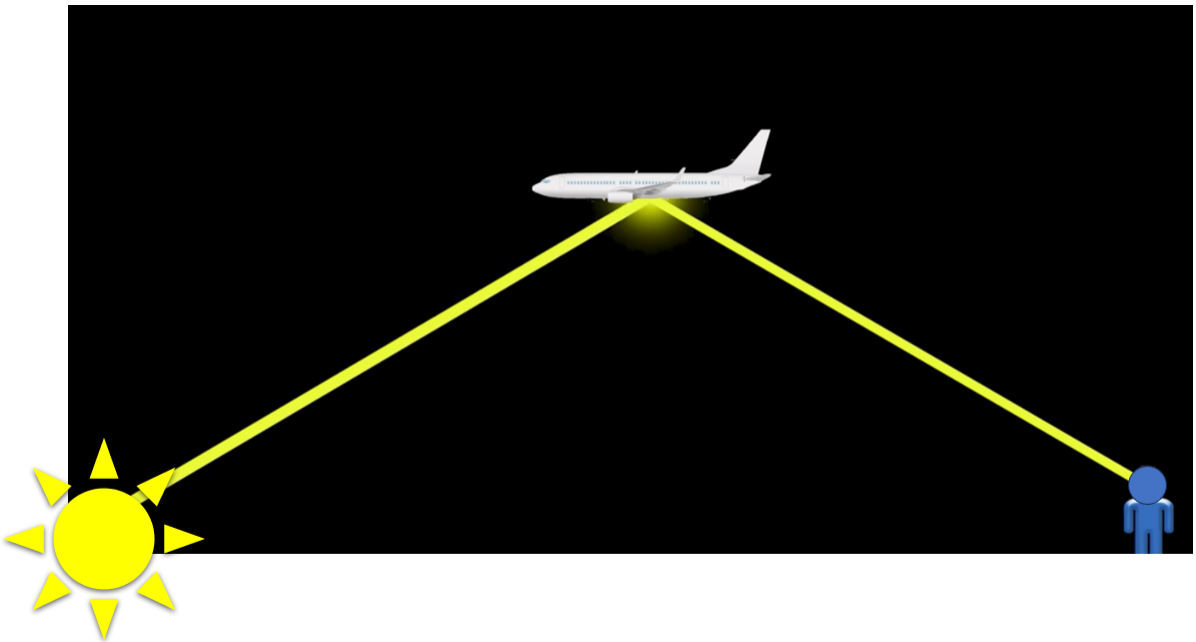
This results in a *p*-value too low to be calculated by standard statistical software. Hence the *p*-value ≈ 0.

translation into english ongoing

(#123) Reflection of the Sun's rays under the fuselage of aircraft

When the Sun is low and an aircraft (typically a commercial aircraft) is high enough, we can observe this (12,000 meters altitude in this case):

Which is impossible on a flat Earth because it would mean that the Sun is at an altitude of less than 12,000 meters. However, according to the flat Earth model, the Sun is local at a constant altitude of about 5,000 kilometers and would be about 50 kilometers in diameter (Sun is a light 32 Miles Across, 1978). So obviously...nothing is right:



Whereas in the context of a spherical Earth, there is no need to live in Walt Disney's world to explain this observation:

translation into englis

Maritime Trips (cruises)

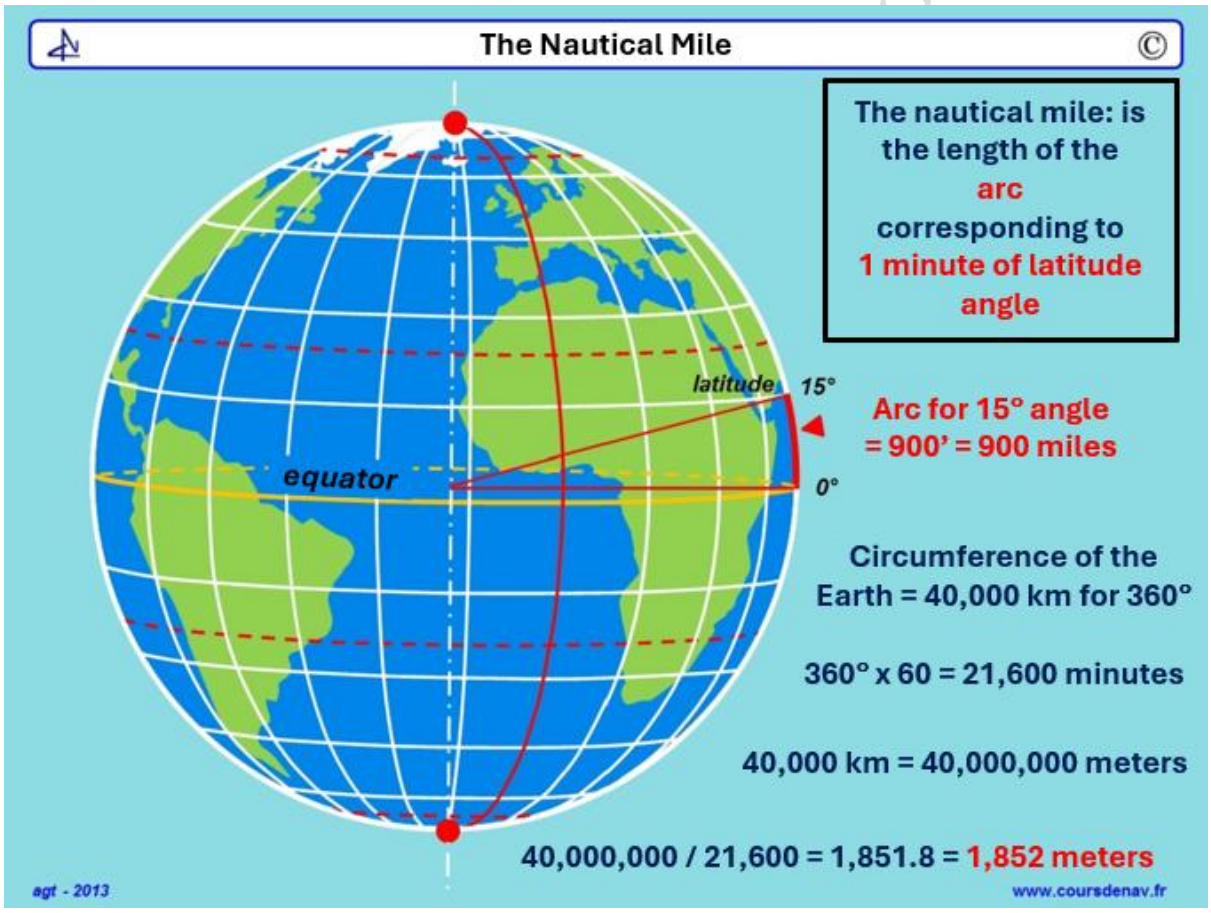
It's not just many airliner flight routes that pose problems impossible to solve on a flat Earth. The same problem applies to international commercial cruises!

(#124) Definition of Nautical Mile/Nautical Mile

All sailors and pilots use the nautical mile as a unit of distance measurement. However, this only works on a spherical Earth !

Indeed, the definition is given by:

The nautical mile (symbol Ma, NMb, nm, nmi or Nqc) is a unit of measurement of length used in maritime and air navigation, conventionally equal to 1,852 meters. The average value of one minute of latitude of an arc of a meridian is 1,851.85 meters, which has been rounded by convention to 1,852 meters.


The Nautical Mile
©
The nautical mile: is the length of the arc corresponding to 1 minute of latitude angle
latitude
15°
0°
equator
Arc for 15° angle = 900' = 900 miles
Circumference of the Earth = 40,000 km for 360°
360° x 60 = 21,600 minutes
40,000 km = 40,000,000 meters
40,000,000 / 21,600 = 1,851.8 = 1,852 meters
agt - 2013
www.coursdenav.fr

But the Earth is not a perfect sphere because it is slightly flattened at the poles, which are modeled in each geodetic system by a flattened ellipsoid of revolution. The initial definition of the nautical mile leads to a variation in length of approximately one percent depending on the latitude, paradoxically greater at the poles (1,861.6 meters) than at the equator (1,842.9 meters). The countries in which the nautical mile was in use historically adopted a value close to that applicable to the latitude of their geographical region and therefore slightly different from one country to another.

In the GPS WGS-84 geodetic system, where the meridian ellipses have a length of approximately 40,008 kilometers, this definition corresponds to an average length of approximately 1,852.2 meters.

In the same geodetic system, the equatorial circle has a length of approximately 40,075 kilometers, or an average value of approximately 1,855.3 meters for one minute of longitude at the equator.

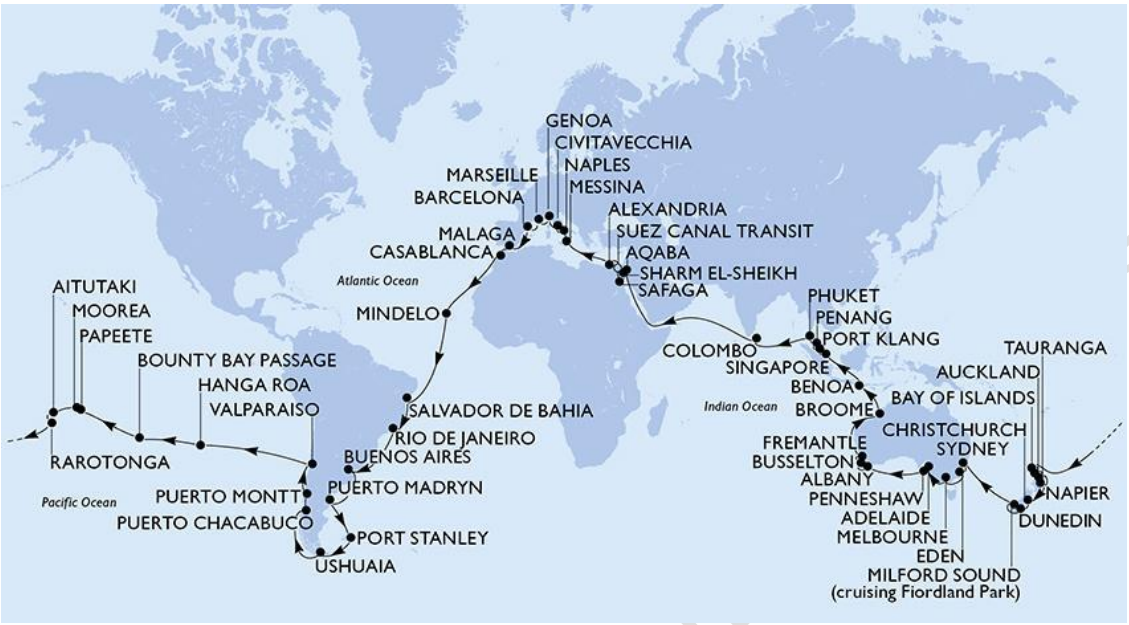
In 1929, the length of the international nautical mile was fixed by convention at the internation and integer value of 1,852 meters, a value to which all countries gradually rallied.

On a flat Earth, the nautical mile has no meaning because, according to the supporters of the infinite flat Earth, a minute of meridian arc varies by a metric distance from 0 to infinity.

translation into english ongoing

(#125) World Tour with MSC

For example, MSC offers the following cruise over 119 nights (including stopover nights):



With stops in 51 cities including the following 22 countries: Italy, France, Spain, Morocco, Cape Verde, Brazil, Argentina, Falkland Islands, Argentina, Chile, Tahiti, French Polynesia, Cook Islands, New Zealand, Australia, Indonesia, Singapore, Malaysia, Thailand, Sri Lanka, Jordan, Egypt.

With the MSC Magnifica ship at the day we write these lines:

MSC MAGNIFICA FACT SHEET

MSC CRUISES | www.msccruisesusa.com | 1-877-665-4655

SHIP DETAILS

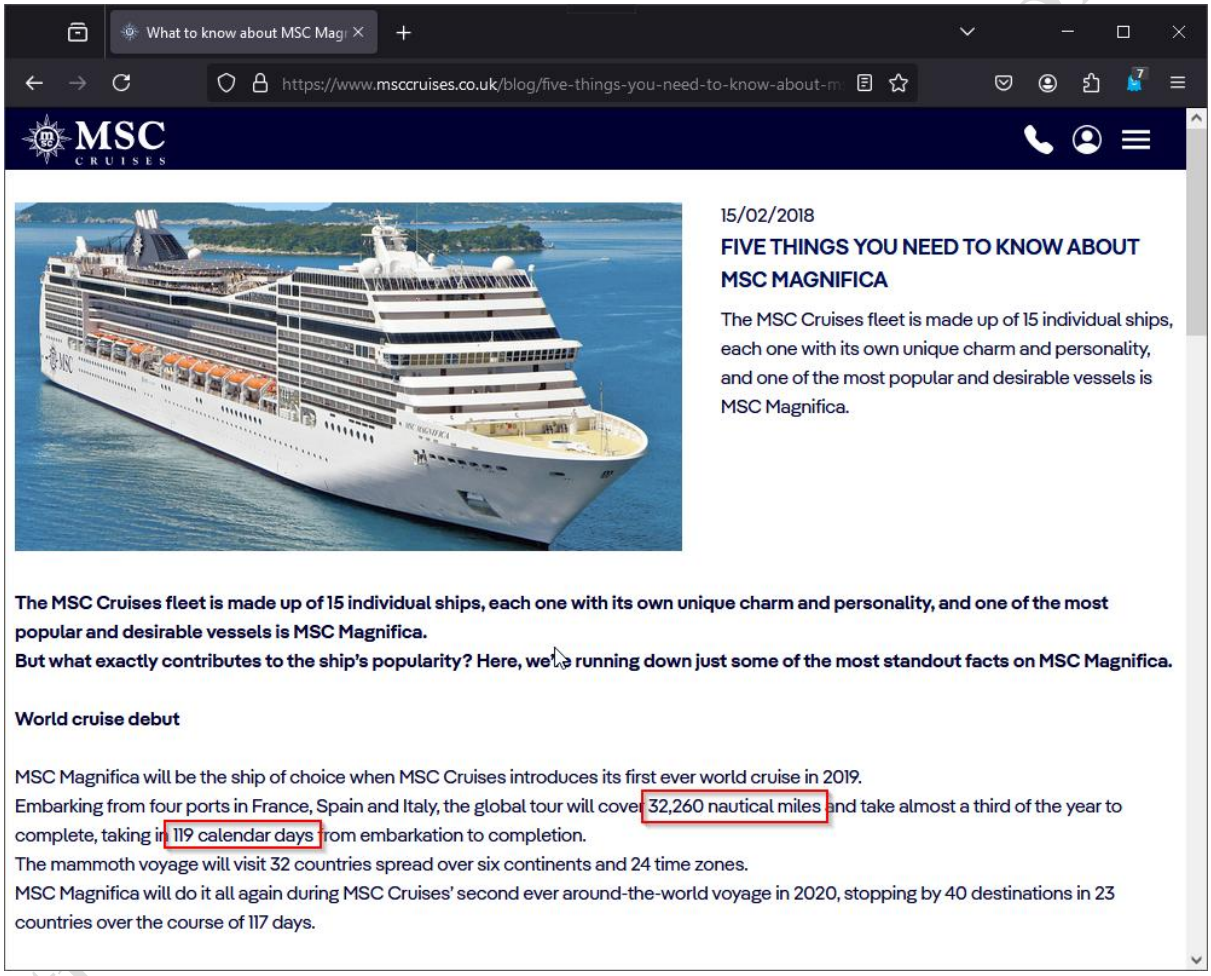
Gross Tonnage	95,128	Beam	106'
Total Staterooms	1,259	Current	110/220 volts
Guests, Double Occupancy	2,518	Passenger Decks	12
Total Guests	3,223	Restaurants	5
Crew (approximate)	1,038	Indoor Bars & Lounges	10
Launch Date	2009	Outdoor Bars & Pool Bars	3
Speed	23 knots	Pools	3
Length	961'	Whirlpools	6

SPECIAL FEATURES

MSC Aurea Spa & Fitness Center, Asian fusion restaurant, gourmet restaurant, pizzeria, *gelateria*, coffee bar, sports bar with billiards, cigar room, covered pool with retractable magrodome, children's splash pool and indoor/outdoor play areas, video arcade, 4D cinema, sports area with game courts, mini-bowling, Internet café, Wi-Fi, iTV, in-room safe & mini-bar, onboard GSM

The cruising speed of this boat is 23 knots, or 42.596 km/h and over a distance of 32,260 nautical miles, or 59,264 kilometers as indicated on the MSC website:

https://www.msccruises.co.uk/blog/five-things-you-need-to-know-about-msc-magnifica


What to know about MSC Magn
https://www.msccruises.co.uk/blog/five-things-you-need-to-know-about-m
MSC CRUISES
15/02/2018
FIVE THINGS YOU NEED TO KNOW ABOUT MSC MAGNIFICA
The MSC Cruises fleet is made up of 15 individual ships, each one with its own unique charm and personality, and one of the most popular and desirable vessels is MSC Magnifica.
The MSC Cruises fleet is made up of 15 individual ships, each one with its own unique charm and personality, and one of the most popular and desirable vessels is MSC Magnifica.
But what exactly contributes to the ship's popularity? Here, we're running down just some of the most standout facts on MSC Magnifica.
World cruise debut
MSC Magnifica will be the ship of choice when MSC Cruises introduces its first ever world cruise in 2019.
Embarking from four ports in France, Spain and Italy, the global tour will cover 32,260 nautical miles and take almost a third of the year to complete, taking in 119 calendar days from embarkation to completion.
The mammoth voyage will visit 32 countries spread over six continents and 24 time zones.
MSC Magnifica will do it all again during MSC Cruises' second ever around-the-world voyage in 2020, stopping by 40 destinations in 23 countries over the course of 117 days.

And this distance and time traveled are much less than the time-distance on a flat Earth using the calculator available here:

http://walter.bislins.ch/bloge/index.asp?page=Distances+on+Globe+and+Flat+Earth

Which proves the globe again. For your information, here are the distances:

Points	Oblate Earth Distance (km)	Flat Earth Distance (km)
Marseille-Barcelona	337	364
Barcelona-Malaga	553	564
Malaga-Casablanca	449	483
Casablanca-Mindelo	2544	2848
Mindelo-Salvador de Bahia	1514	2009
Salvador de Bahia-Rio de Janeiro	1209	1281
Rio de Janeiro-Buenos Aires	1968	2214
Buenos Aires-Puerto Madryn	1077	1124
Puerto Madryn-Port Stanley	1096	1108
Port Stanley-Ushuaïa	607	640
Ushuaïa-Puerto Chacabuco	1086	1094
Puerto Chacabuco-Puerto Montt	444	444
Puerto Montt-Valparaiso	945	948
Valparaiso-Hanga Roa	3678	4363
Hanga Roa-Bounty bay passage	2073	2558
Bounty bay passage-Papeete	2172	2702
Papeete-Moorea	27	37
Moorea-Aitutaki	1089	1429
Aitutaki-Rarotonga	263	263
Rarotonga-Bay of Islands	2093	2310
Bay of Islands-Auckland	189	192
Auckland-Tauranga	154	170
Tauranga-Napier	210	215
Napier-Dunedin	882	922
Dunedin-Milford Sound	246	265
Milford Sound-Sydney	1864	2021
Sydney-Eden	374	380
Eden-Melbourne	444	510
Melbourne-Adelaïde	653	734
Adelaïde-Penneshaw	106	112
Penneshaw-Albany	1716	2002
Albany-Busselton	278	313
Busselton-Fremantle	181	183
Fremantle-Broome	1696	1765
Broome-Benoa	1274	1460
Benoa-Singapore	1506	2046
Singapore-Port Klang	326	453
Port Klang-Penang	271	293
Penang-Phuket	833	1179
Phuket-Singapore	942	1155
Singapore-Colombo	2729	4011
Colombo-Safaga	5317	6658
Safaga-Sharm El-Sheikh	139	142
Sharm El-Sheikh-Aqaba	186	190
Aqaba-Suez Canal Transit	237	285

translation into english ongoing

Suez Canal Transit-Alexandrie	246	292
Alexandrie-Messina	1519	1715
Messina-Naples	315	321
Naples-Civitavecchia	249	272
Civitavecchia-Genoa	343	363
Genoa-Marseille	309	340
Total	**29250**	**33458**

That's a difference of **more than 18%**!!!! Obviously any passenger would realize this difference in terms of cruising days (~21 days more!) given the cruising speed of the MSC Magnifica!

So given the significant difference in distance and time the cruise ship has to travel... either MSC is lying to everyone and the thousands of tourists who disembark from the cruise every year are lying to the entire planet, or the flat Earth is a fantasy or a lie!

translation into english ongoing

Circumnavigation of Antarctica below the 60th parallel (south)

(#126) Mariusz Koper record (2018)

Mariusz Koper, skipper of Offshore Yachts is a businessman and owner of the S/Y Katharsis II, length: 22 meters (type: Oyster; built by: Rob Humphrey; shipyard: Wroxham Marine, UK; construction material: fiberglass; year of construction: 2009).

Mariusz Koper, skipper with 20 years of experience, sails this yacht to fulfill his sailing dreams; he has rounded Cape Horn twice. Among his many voyages to different parts of the planet, some have been particularly challenging, including the Northwest Passage from the Atlantic to the Pacific in 2012, as well as voyages to Antarctica beyond the Subantarctic Circle to the Antarctic Peninsula in 2011 and to the Ross Sea in 2015, which is only open to navigation for a few weeks a year. During this latest expedition, Koper reached the Bay of Whales, the southernmost point of open ocean on Earth and the closest point to the South Pole.

translation in progress

Mariusz Koper traveled approximately 17,000 nautical miles (9,179 km) from January 5, 2018 to March 2018 during his circumnavigation of Antarctica (72 days and 6 hours), setting a world record.

On 5 April 2018, after a non-stop journey that lasted 102 days 22 hours 59 minutes and 5 seconds, they reached Hobart, Tasmania, Australia, having successfully completed the Antarctic Loop south of 60° between 08:00 UTC on 7 January and 14:00 UTC on 20 March 2018 in a time of 72 days 6 hours. The voyage was completed and authenticated under the auspices World Sailing Speed Record Council.

But as we have shown in the case of the Vendée Globes (see page 672) with a flat Earth and competition boats, this would require a trip between 160 and 210 days... or to sail at a speed of approximately 60 km/h during 72 days.

So again the subject is closed!

translation into english ongoing

(#127) Lisa Blair record (2022)

Mariusz Koper's record is the first crewed circumnavigation of Antarctica south of the 60th parallel (2017-2018), while Lisa Blair's is the fastest solo, non-stop, unassisted circumnavigation of Antarctica (2022). The main difference lies in whether the trip was crewed or solo, and in the nature of the achievement (first circumnavigation versus speed record).

Lisa left Albany on February 21, 2022, and returned after spending three months in the Southern Ocean battling weekly snowstorms, cyclonic winds, and waves reaching the height of a five-story building.

Lisa set a new crossing record during the yearly Antarctica Cup Yacht Race by arriving in Albany port on May 25, 2022, with a time of 92 days, 18 hours, 21 minutes and 22 seconds (below in green her first "failed" attempt in 2017 following a dismasting and the successful one in 2022).

translation in progress

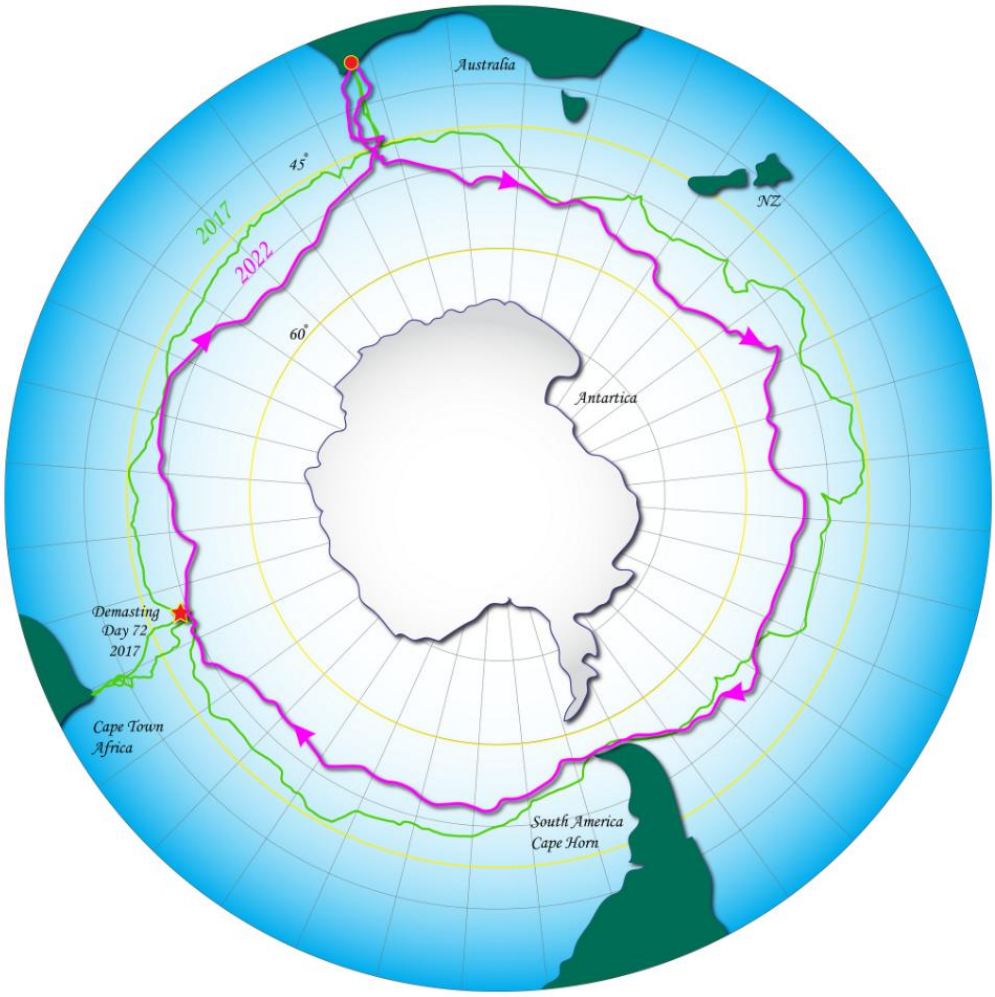


Figure 68 Lisa Blair's Roads © Carolyn Grant

But once again, as we demonstrated in the case of the Vendée Globe (see page 672) with a flat Earth and racing boats, this would require between 160 and 210 days… ... or sailing at a speed of about 50 km/h for 92 days.

So, once again, the subject is settled!

translation

(#128-136) Jules Verne Trophy

In 2022, Lisa Blair set the record for a solo circumnavigation of Antarctica in 92 days and 18 hours on a 15-meter monohull. Francis Joyon holds the record for a solo round-the-world voyage on a multihull (2004, then improved in 2008) in 72 days and 22 hours, and with his crew on IDEC Sport, he completed the Jules Verne Trophy in 40 days and 23 hours! The difference is therefore twofold: time (Joyon was much faster) and technique (ultra-fast multihull vs. slower monohull, and a global route vs. an Antarctic one). In total, there are 9 officially recognized Jules Verne records, and therefore 9 impossible feats on a flat Earth!

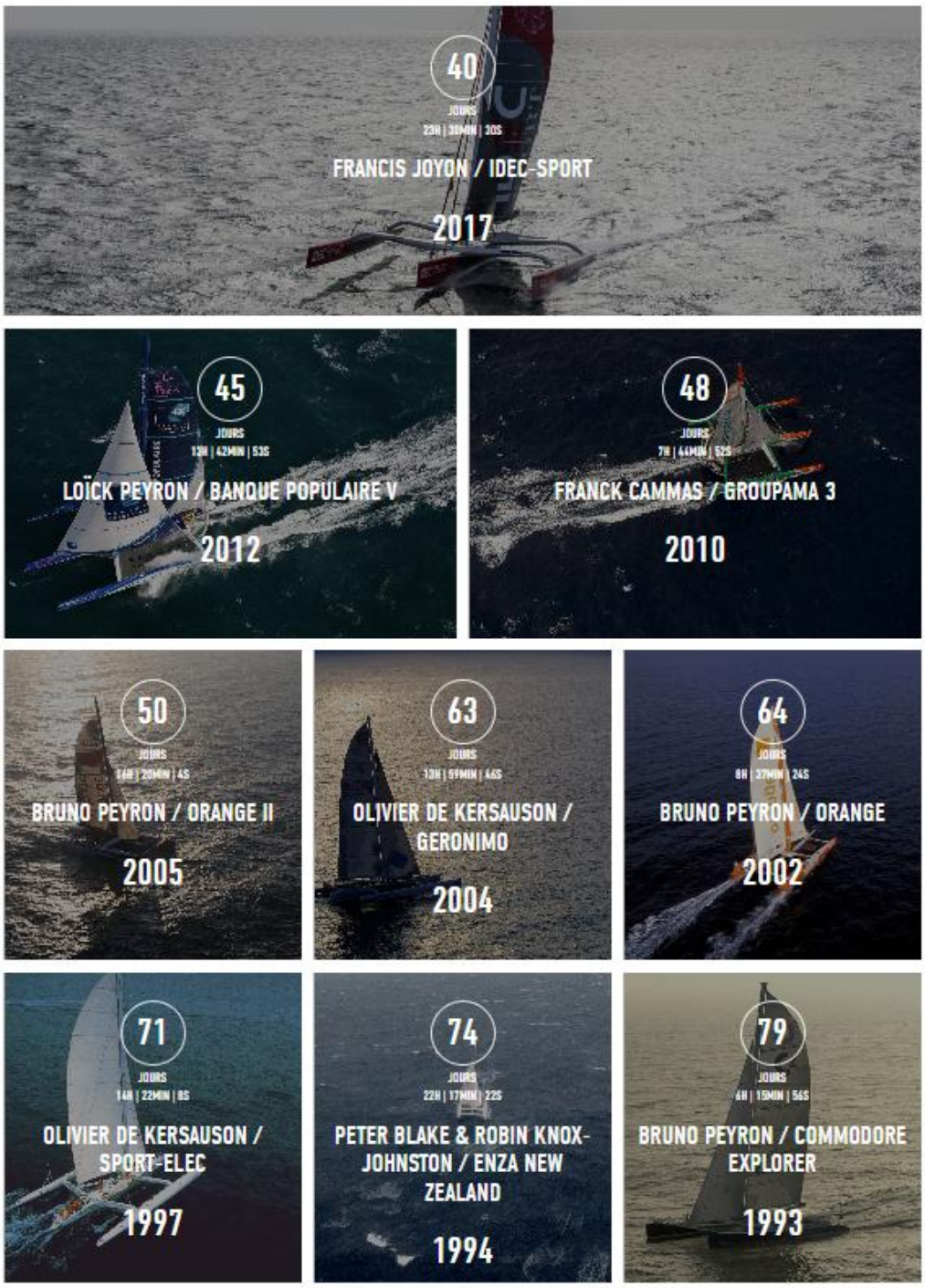
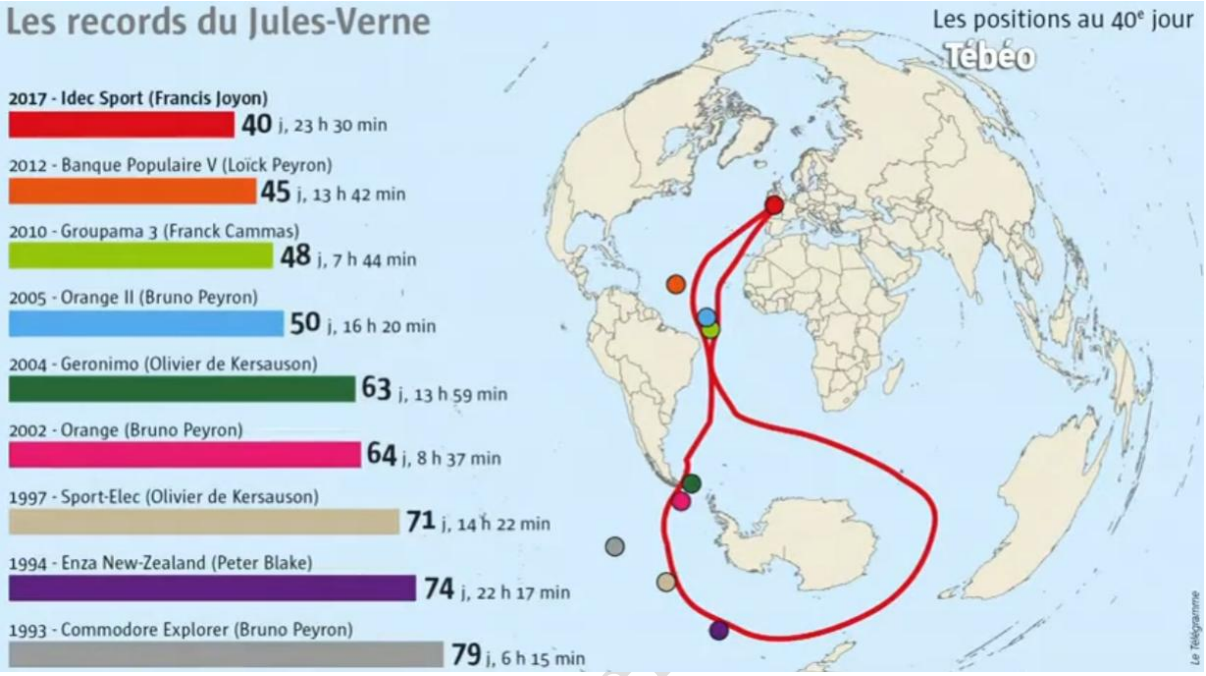


Figure 69 Official Jules Verne Trophy records https://www.tropheejulesverne.org/courses/

But once again, as we have proved it in the case of the Vendée Globe (see page 672) with a flat Earth and racing boats, this would require between 160 and 210 days… ... or sailing at a speed of about 100 km/h for 40 days.

So, once again, the matter is settled!


Les records du Jules-Verne
2017 - Idec Sport (Francis Joyon)
40 j, 23 h 30 min
2012 - Banque Populaire V (Loïck Peyron)
45 j, 13 h 42 min
2010 - Groupama 3 (Franck Cammas)
48 j, 7 h 44 min
2005 - Orange II (Bruno Peyron)
50 j, 16 h 20 min
2004 - Geronimo (Olivier de Kersauson)
63 j, 13 h 59 min
2002 - Orange (Bruno Peyron)
64 j, 8 h 37 min
1997 - Sport-Elec (Olivier de Kersauson)
71 j, 14 h 22 min
1994 - Enza New-Zealand (Peter Blake)
74 j, 22 h 17 min
1993 - Commodore Explorer (Bruno Peyron)
79 j, 6 h 15 min
Les positions au 40e jour
Tébéo

Or in table format:

Boat	Start Date	End Date	Record	Retention duration in days
Idec-Sport	2016-12-16	2017-01-26	40d-23h-30min.	2191
Banque Populaire V	2011-11-22	2012-01-06	45d-13h-42min	1847
Groupama	2010-01-31	2010-03-20	48h-7h-44min	657
Orange II	2005-01-24	2005-03-16	50d-16h-20min	1830
Geronimo	2004-02-25	2004-04-29	63d-13h-59min	321
Orange II	2002-03-02	2002-05-05	64d-08h-37min	725
Sport-Elec	1997-03-08	1997-05-19	71d-14h-22min	1812
Enza New Zealand	1994-01-16	1994-04-01	74d-22h-17min	1144
Commodore Explorer	1993-01-30	1993-04-20	79d-06h-15min	346

Vendée Globe

The Vendée Globe is covered at page 672 in the section on sporting competitions around Antarctica.

translation into english ongoing

Sun

Here we will focus on evidence for the oblate Earth relative to the Sun. There are indeed a number of insoluble problems with the flat Earth model and our Sun (which, as a reminder, is a G2V star, aka a yellow dwarf).

(#137) Local Sun and crepuscular rays / Faraday-Tyndall effect

According to the method used by flat Earth supporters to calculate the Earth-Sun distance based on the rules of Trigonometry (Opera Magistris, 2024) and using the technique of crepuscular rays, depending on the context (Crepuscular rays: laboratory experiments and simulations, 2011), the local Sun is then approximately 3.15 meters away as illustrated below:

Figure 70 Crepuscular rays (author: Brocken Inaglory, source: Wikipedia)

Based on the famous trigonometric relationship of the right triangle (Opera Magistris, 2024):

$$\tan(\theta) = \frac{\text{opposite}}{\text{adjacent}}$$

So the local Sun of the flat Earth proponents is really very very local... Obviously the flat Earth model is therefore false since anyone who lives on the 2nd floor of a building could verify that they could not touch the Sun...

Note that some flat Earth proponents prefer to use the law of sines by taking two rays:

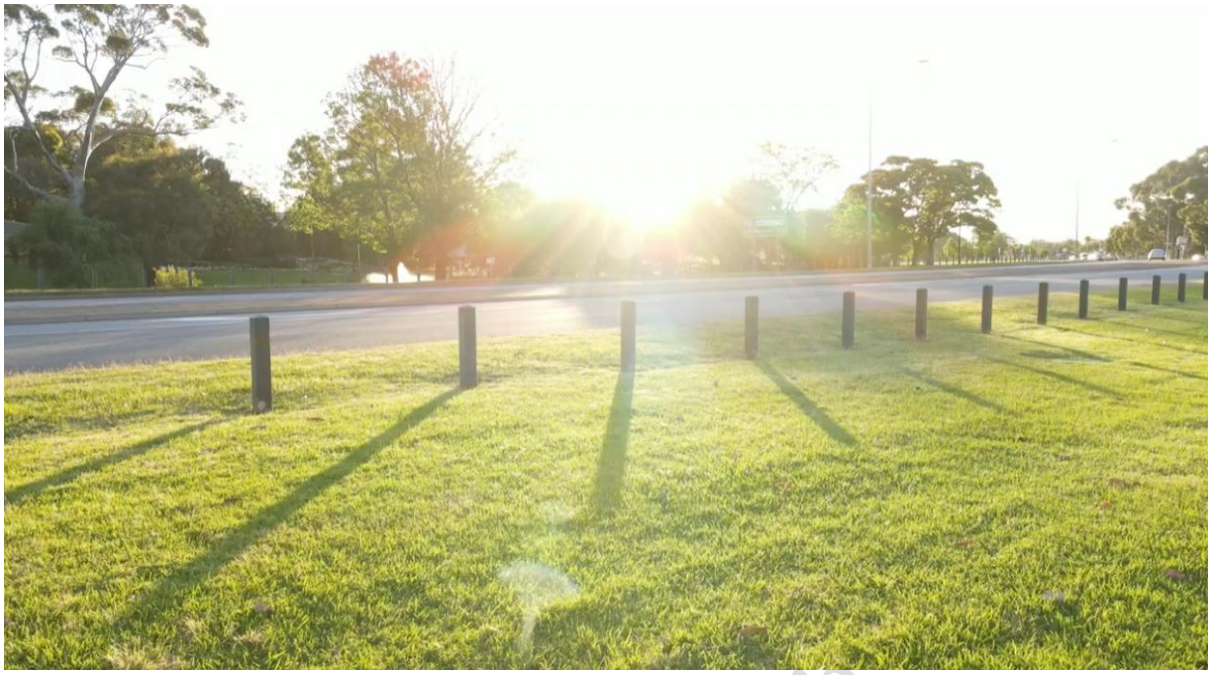
As a reminder (involving angle and respective opposite side as proved in (Opera Magistris, 2024)) :

$$\frac{\sin(\hat{A})}{A} = \frac{\sin(\hat{B})}{B} = \frac{\sin(\hat{C})}{C}$$

Which gives the same result of a Sun at about 3.15 meters according to the twilight ray method therefore…

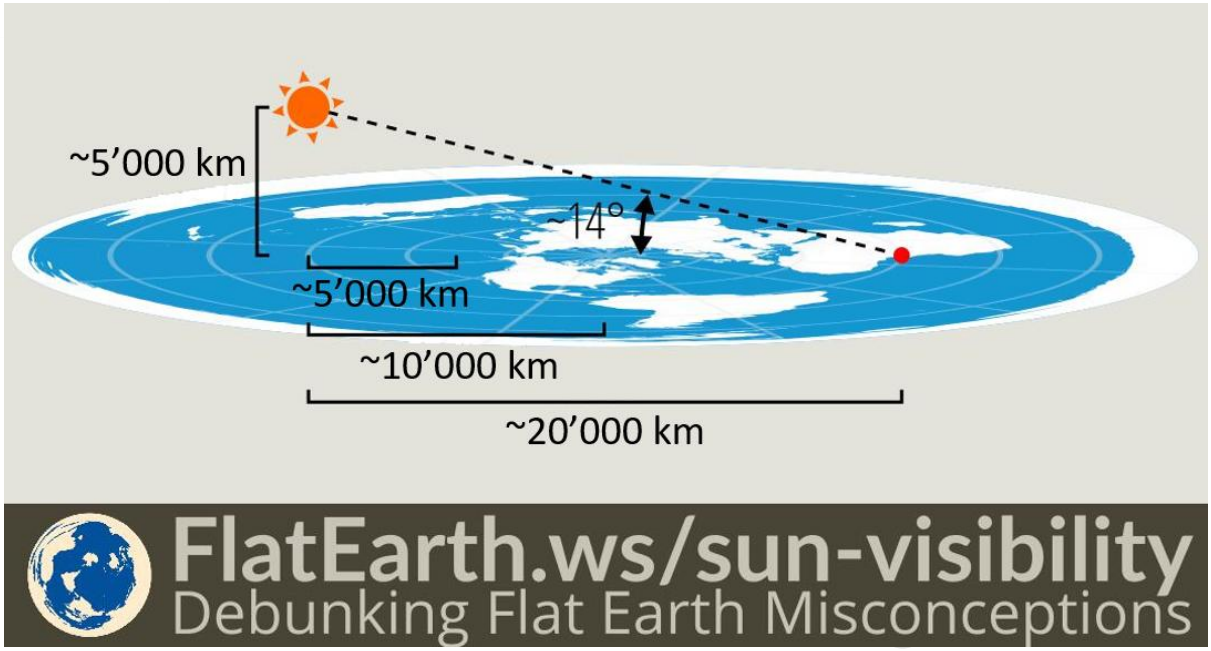
The video is available here:

https://www.youtube.com/watch?v=keNI5yHlyLk



Where the shadows appear to be not parallel to most people, however if we go up a bit with the drone we have…:

If the Earth was flat, the Sun should be visible above the horizon at all times from the entire Earth as we know according to the law of linear perspective (Opera Magistris, 2024). This is not the case, and this simple fact should have been enough to rule out any possibility of a flat Earth:



Q.E.D.…

According to flat-Earthers, this is evidence that the Sun is not far.
In that case, can we really take this as evidence the Sun is underground?
In reality, those sun rays are practically parallel...
... just like these buildings are actually parallel.
The parallel sun rays do not appear parallel due to perspective effect.
This phenomenon is called the crepuscular rays.
FlatEarth.ws/crepuscular
Debunking Flat Earth Misconceptions

Oh… and by the way:

translatio ing

(#138) Variation in the apparent size of the Sun

If the Sun is local (remember that this hypothesis is imposed by the supporters of the flat Earth), its variation in apparent size would be significant and easily measurable!

In reality, we have an apparent size variation of 2.4% (between 0.524° and 0.5418° hence a variation of approximately 0.0178°) between the closest and furthest point of the orbit:

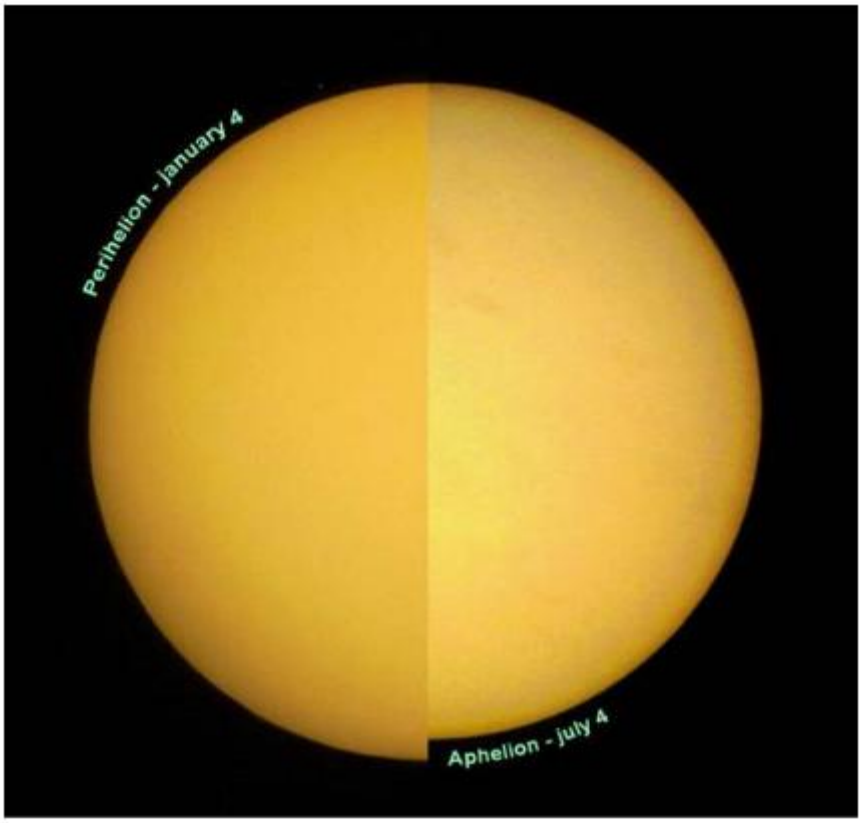
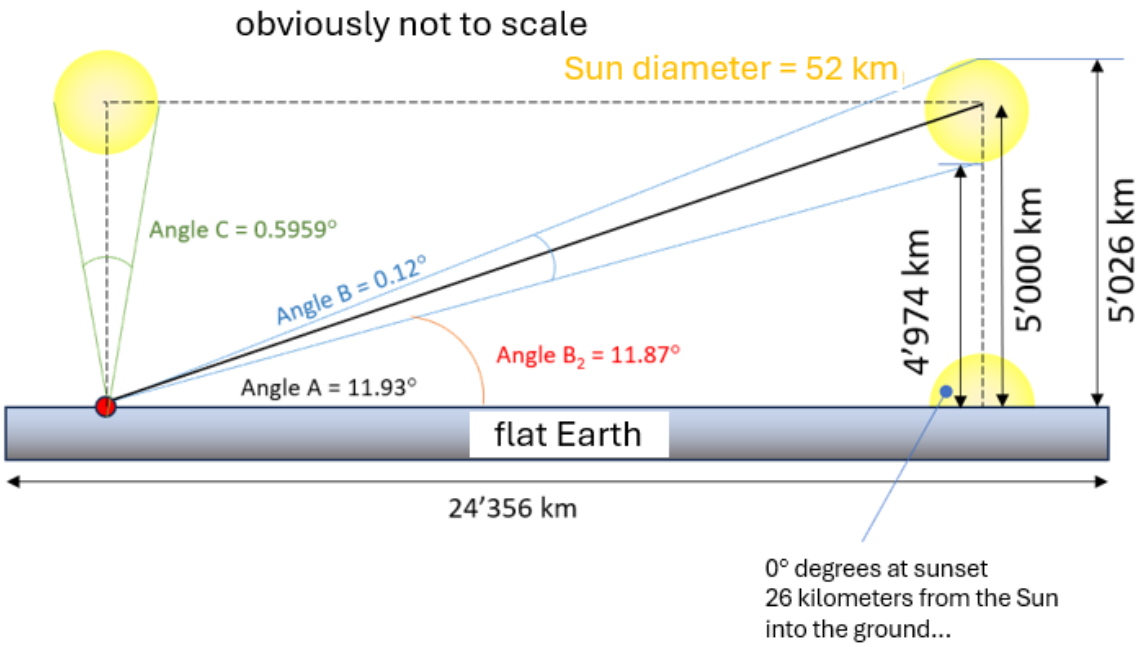


Figure 71 Variation in the apparent size of the Sun (source: NASA)

Remark: It should also be noted that the fact that the Sun is larger in winter than in summer contradicts the flat Earth hypothesis because if the Sun is larger in winter, then it should be warmer in winter than in summer, according to flat-Earthers. Therefore, they contradict themselves!

Whereas on a flat Earth:

translation



We have for the angle of the Sun above the horizon at a far distance:

$$\text{Angle } A = \tan\left(\frac{5{,}000}{24{,}356}\right) = 11.93^{\circ}$$

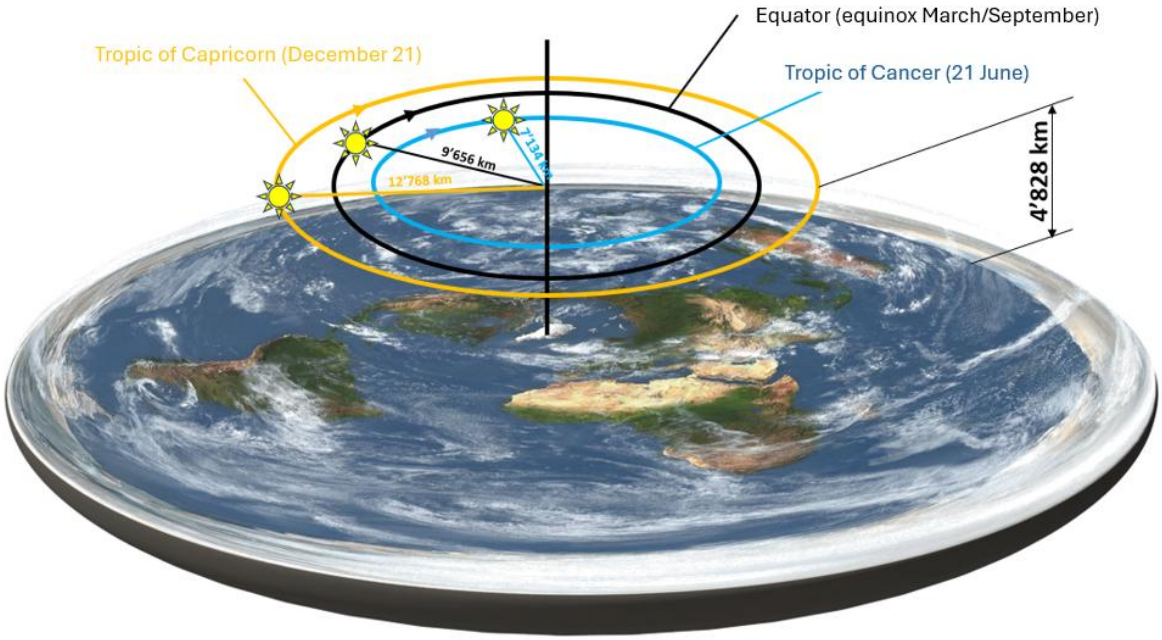
We have the angular size of the Sun at the far distance:

$$\text{Angle } B = \tan\left(\frac{5{,}026}{24{,}356}\right) - \tan\left(\frac{4{,}974}{24{,}356}\right) = 0.12^{\circ}$$

And for the angular size of the Sun at noon:

$$\text{Angle } C = 2 \cdot \tan\left(\frac{26}{5\,000}\right) = 0.5959^{\circ}$$

translation into engl

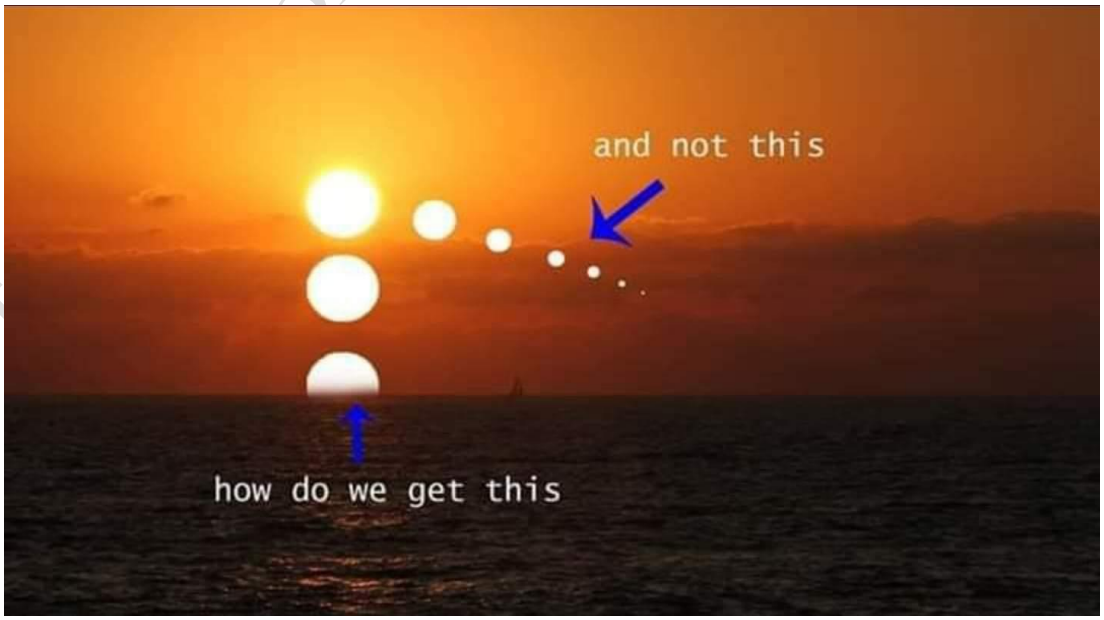


According to the flat Earth hypothesis, in what seems the most widely accepted hypothesis, taking into account "perspective" in its widest orbit, the Sun would always be visible at least 11 degrees above the horizon.

According to this hypothesis, due to the assertion of "perspective," the Sun would also be visible five times smaller at this point than at noon.

So we have a variation of 0.12° degrees in the angular size of the Sun (about 10% or 4 times more than in the standard model...) within the framework of the hypothesis of the flat Earth supporters. This has never been confirmed experimentally!

Moreover... if the flat-earth hypothesis respected the laws of linear perspective, we would have:

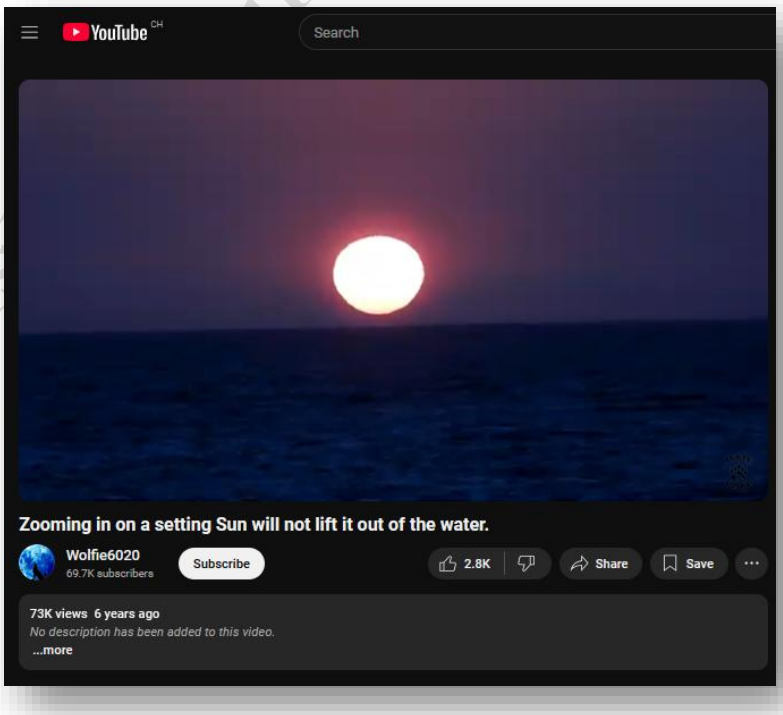


In the flat Earth model, the distance to the Sun varies throughout the day. The almost constant apparent size of the Sun proves that the Earth is not flat and that the Sun is very far away!

And contrary to the lies and manipulations of flat Earth advocates, zooming in on the Sun does not make it reappear as illustrated in the photo mosaic below:

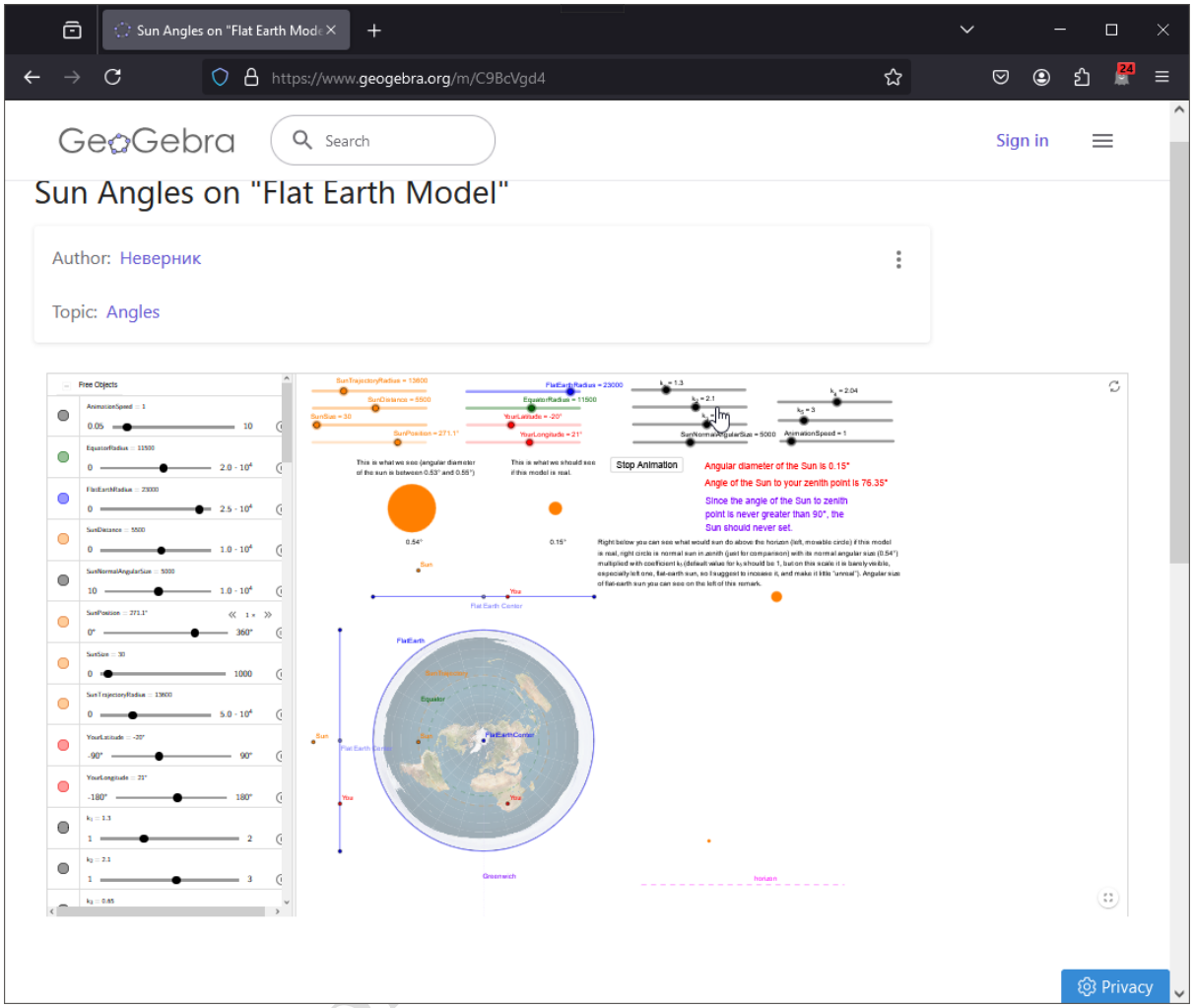
Whose original YouTube video is available here:

https://www.youtube.com/watch?v=gzjFOZ00Ka8



There is an apparent size simulator of the Sun available here:

https://www.geogebra.org/m/C9BcVgd4


Sun Angles on "Flat Earth Mod
https://www.geogebra.org/m/C9BcVgd4
GeoGebra
Search
Sign in
Sun Angles on "Flat Earth Model"
Author: Неверник
Topic: Angles
Stop Animation
Angular diameter of the Sun is 0.15°
Angle of the Sun to your zenith point is 76.35°
Since the angle of the Sun to zenith point is never greater than 90°, the Sun should never set.
Privacy

And beware of the atmospheric diffusion effect which can make you believe that the Sun is changing size when with a filter you can see that this is not the case:

The original video is available here:

https://flatearth.ws/wp-content/uploads/2020/11/sun-glare.mp4?_=1

https://flatearth.ws/wp-content/uploads/2020/11/sun-glare.mp4?_=1
Sunlight is very intense. It can cause glare to appear around the sun & the sun can appear larger than the actual size. To observe the sun's actual size, we need to eliminate the glare by reducing the camera's exposure or by using a solar filter.
Credit: wolfie6020
Without a solar filter
With a solar filter
During sunset, sunlight gradually becomes less intense, & sun glare becomes smaller. If the glare is not eliminated, the sun can appear as if it is shrinking & flat-Earthers incorrectly use it as "evidence" that the sun is moving away from us.
FlatEarth.ws/sun-glare
0:02 / 0:09

translation into

(#139) Sun and Moon on the Horizon and Laws of Perspective

The fact that the Sun and the Moon appear and disappear from the horizon with a geometry that violates the laws of linear perspective, in particular the homographic equations given for reminder by (Opera Magistris, 2024):

$$y' = \frac{y\Delta}{z + \Delta}$$

$$x' = \frac{x\Delta}{z + \Delta}$$

contradicts a flat Earth model where the Sun and Moon always remain at a fixed altitude above the flat Earth.

Figure 72 Full cycle of a sunset over the high plains of the Mojave Desert on June 6, 2015 (author: Jessie Eastland)

transla going

Figure 73 The moon sets at night over the North Atlantic off Brighton (author: Dominic Alves)

The optical deformations (wavelets) of the Sun are also very well explained by classical models based on the oblate Earth (Atmospheric phenomena before and during sunset, 1980).

Furthermore, this observation contradicts the model of flat Earth proponents who claim that the Sun is at a constant height above the flat Earth at a distance of only a few thousand kilometers (between 640 and 1,130 kilometers, therefore a margin of error of about 50% since no one among flattards agrees because they are incapable of measuring anything)...

translation into engl

Solar Eclipses

Solar eclipses make no sense on a flat Earth since, according to flattards, the Sun and Moon are local.

There are two major problems with solar eclipses and the flat Earth. Let's see what they are:

(#140) Hidden side of the Moon illuminated by the Sun

Indeed, if the Moon covers the Sun in an apparent way for observers located in the shadow of the eclipse... then at the same time, other observers on the same flat Earth should observe the hidden side of the Moon completely illuminated as illustrated below where we imagine a total eclipse of the Sun passing over Australia:

translation into engl

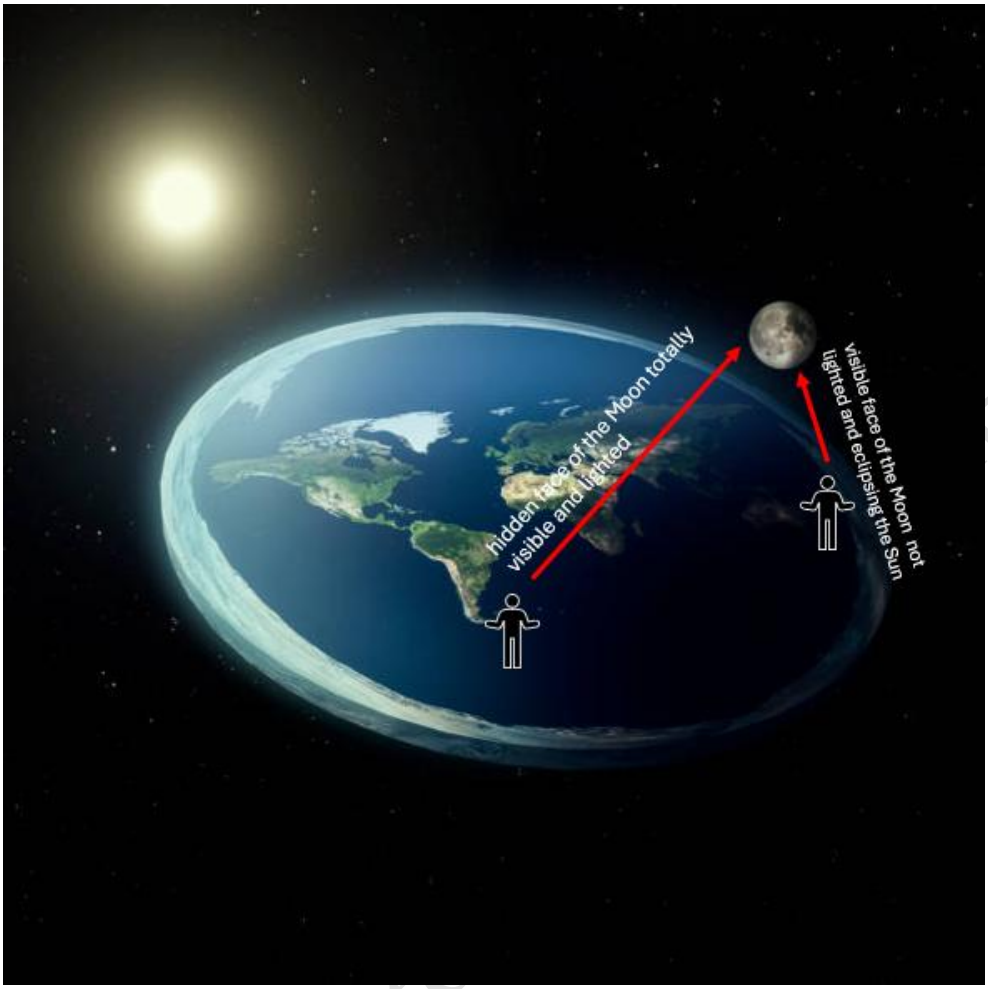


Figure 74 Solar eclipse nonsense on a flat Earth depicted

Which is not observed (never had photos of the far side of the Moon from Earth) so the flat Earth hypothesis is wrong!

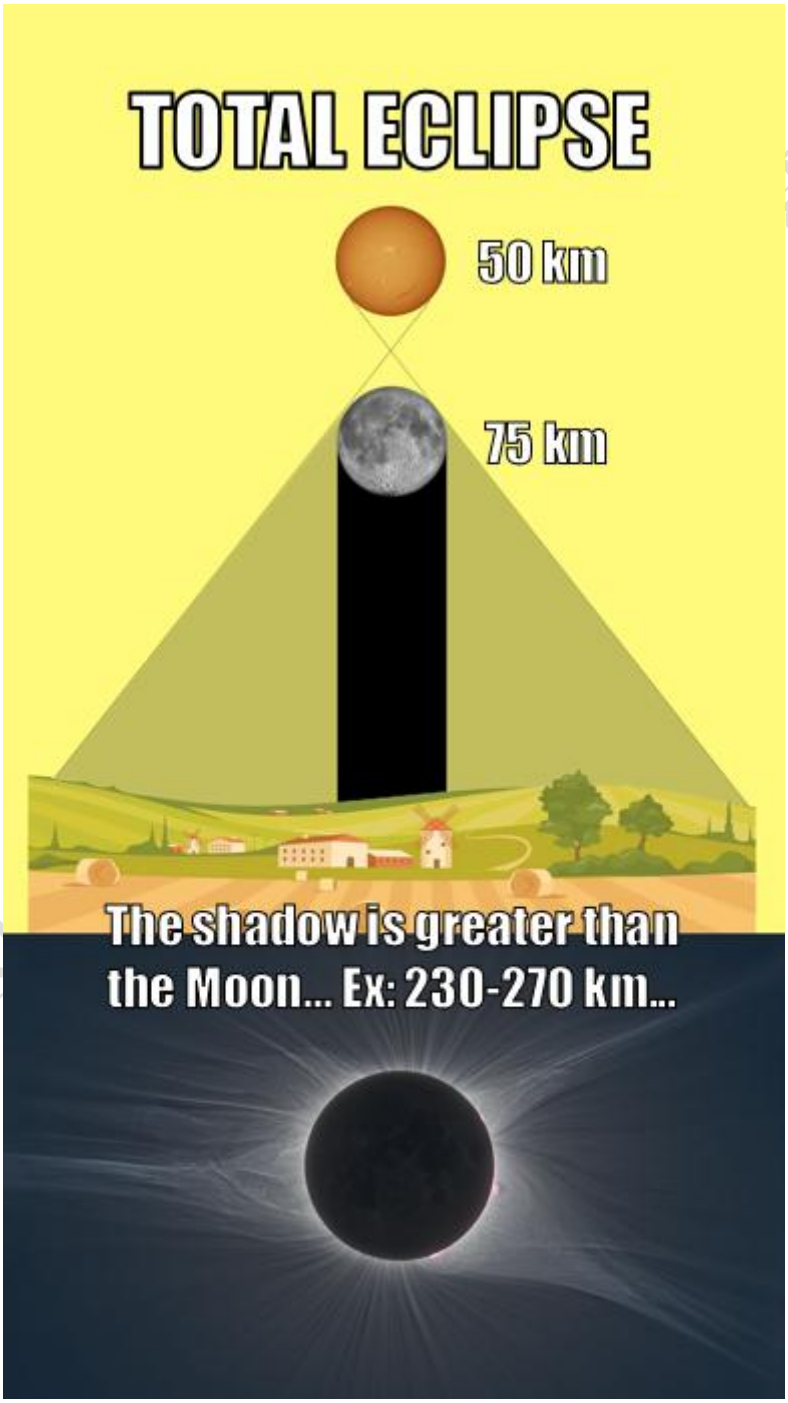
translation int ng

(#141) Size of shadow and penumbra

An annular eclipse on the flat Earth requires the Moon to be smaller than the Sun.

A total eclipse with an umbra that is 270 kilometers in diameter (the umbra, not the penumbra), with a Sun that is 50 kilometers in diameter requires a Moon that is larger than the Sun...

Here are the three possible configurations, and each poses an insurmountable problem in the flat Earth hypothesis:



Which therefore contradicts the possibility of annular eclipses on a flat Earth!

(#142) Analema (Equation of Time)

The analemma or analema (masculine noun, from the ancient Greek ἀνάλημμα / análêmma, "support, substruction", based on the same root as the word λῆμμα / lẽmma, "lemma") is the figure traced in the sky by the different positions of the Sun recorded at the same time and from the same place during a calendar year.

From Earth, the analemma has the shape of a stretched and asymmetrical 8 figure, with the upper loop smaller than the other. This shape is more or less inclined relative to the horizontal depending on the chosen time: it is almost vertical if we note the position of the Sun at noon, otherwise the figure eight is inclined to the left in the morning and to the right in the afternoon. The Sun is at the top of the analemma at the summer solstice, and at the bottom at the winter solstice. The analemma is lower on the horizon as the latitude increases. Local noon intersects the analemma at 4 points corresponding to the dates for which there is no difference.

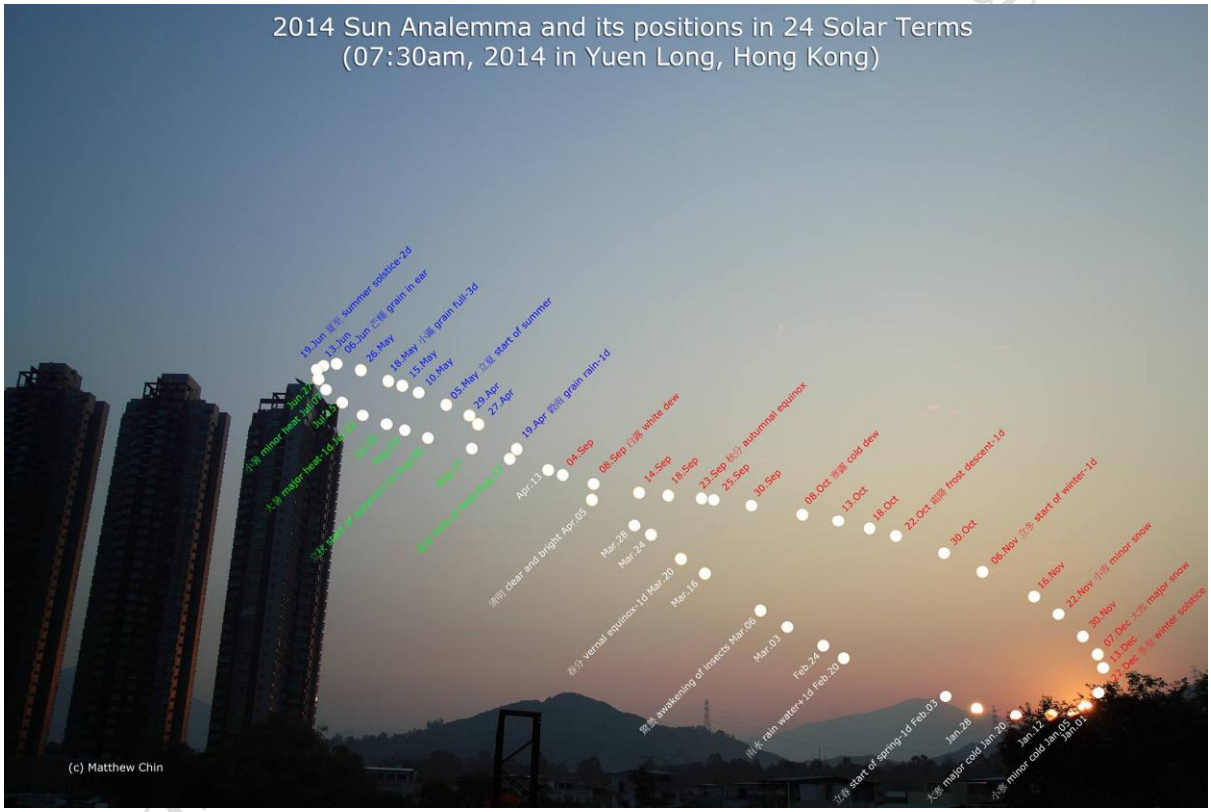


Figure 75 Real analemma and its positions in 24 Solar Terms (author: ©Matthew Chin)

The detailed mathematical proof is available here over 15 pages:

http://info.ifpan.edu.pl/firststep/aw-works/fsII/mul/mueller.pdf

This paper was awarded in the II International Competition (1993/94) "First Step to Nobel Prize in Physics" and published in the competition proceedings (*Acta Phys. Pol. A* **88** Supplement, S-49 (1995)). The paper is reproduced here due to kind agreement of the Editorial Board of "Acta Physica Polonica A".

EQUATION OF TIME — PROBLEM IN ASTRONOMY

M. MÜLLER

Gymnasium Münchenstein, Grellingerstrasse 5,
4142 Münchenstein, Switzerland

Abstract

The apparent solar motion is not uniform and the length of a solar day is not constant throughout a year. The difference between apparent solar time and mean (regular) solar time is called the equation of time. Two well-known features of our solar system lie at the basis of the periodic irregularities in the solar motion. The angular velocity of the earth relative to the sun varies periodically in the course of a year. The plane of the orbit of the earth is inclined with respect to the equatorial plane. Therefore, the angular velocity of the relative motion has to be projected from the ecliptic onto the equatorial plane before incorporating it into the measurement of time. The mathematical expression of the projection factor for ecliptic angular velocities yields an oscillating function with two periods per year. The difference between the extreme values of the equation of time is about half an hour. The response of the equation of time to a variation of its key parameters is analyzed. In order to visualize factors contributing to the equation of time a model has been constructed which accounts for the elliptical orbit of the earth, the periodically changing angular velocity, and the inclined axis of the earth.

PACS numbers: 95.10.Ce

1. Introduction

1.1. The measurement of time

This paper deals with a problem of the astronomical measurement of time. Let us first introduce some basic definitions. The natural unit of time is the rotation of the earth, that is the apparent daily course of the sun. The length of time between two culminations of the sun is called a *solar day*. The time-system based on this unit is called *apparent solar time*. By this system, localities on a given meridian always have the same time-readings.

A comparison of a sundial with a mechanical clock shows that the solar day has a variable length. Therefore, so-called *mean solar time* is commonly used. This is based on a unit which is defined as the average of a solar day. The mean solar time has been

The final equation of the mathematical developments gives (the factors in front of the trigonometric functions come from the eccentricity of the Earth's orbit which is currently $e \cong 0.0167$ and the obliquity of the Earth's rotation which is currently $\varepsilon \cong 23.45°$):

Equation of Time

$$\begin{aligned} &\cong -591.7\sin\big(2(M+P)\big) - 459.6\sin(M) \\ &+ 19.8\sin(2M+2P) - 19.8\sin(3M+2P) - 12.8\sin\big(4(M+P)\big) \\ &- 4.8\sin(2M) + 0.9\sin(3M+4P) - 0.9\sin(5M+4P) \\ &- 0.5\sin(4M+2P) - 0.4\sin(6(M+P)) \end{aligned}$$

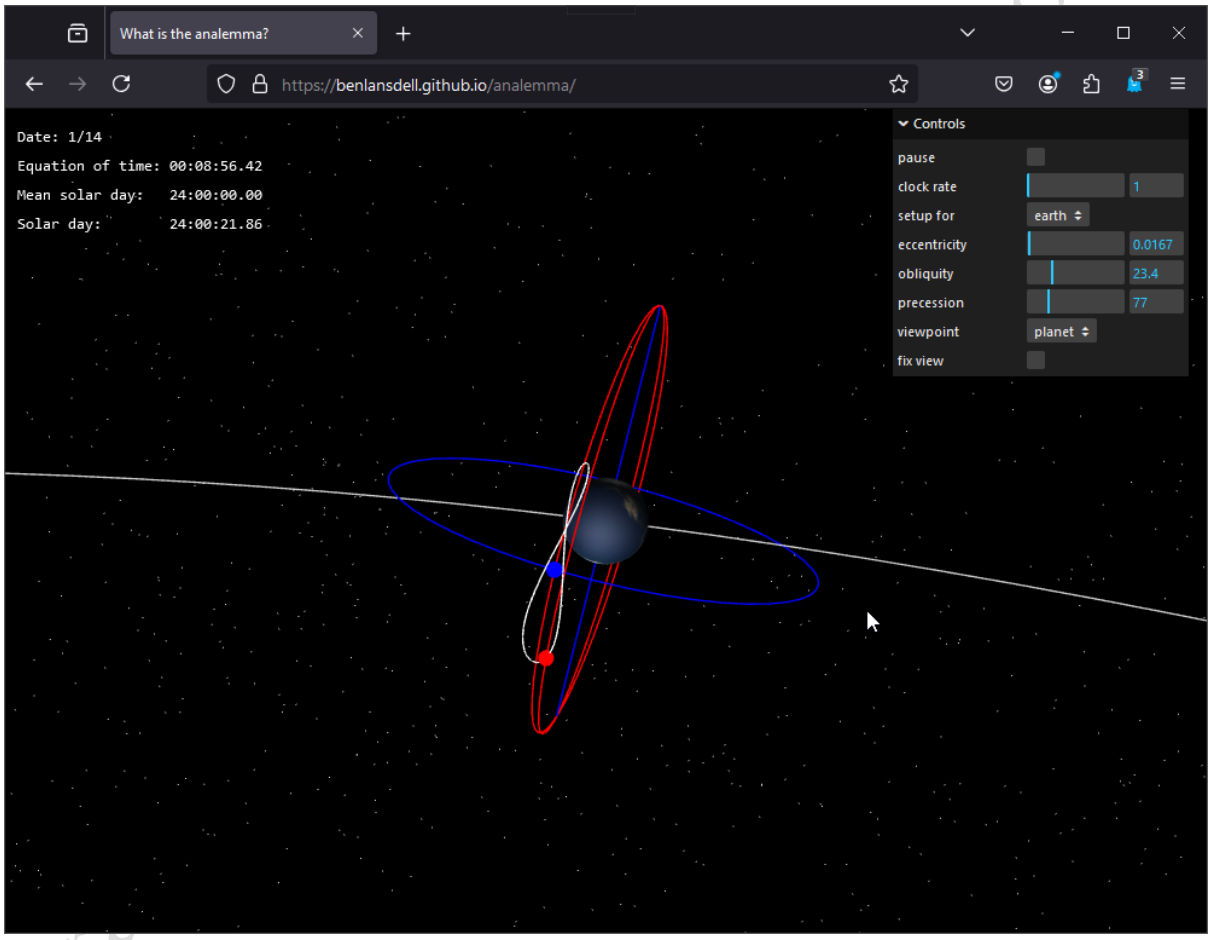
where P is currently about 12.25 degrees and M is the mean anomaly angle of Earth's orbit (that is, the angle of Earth on its orbit if the latter was a perfect circle).

Remark: And even more detailed derivation can be found in (Opera Magistris, 2024).

Flat Earth proponents have never been able to formalize the analemma but explain it with rhetorical flourishes that make no sense if asked to put them on paper.

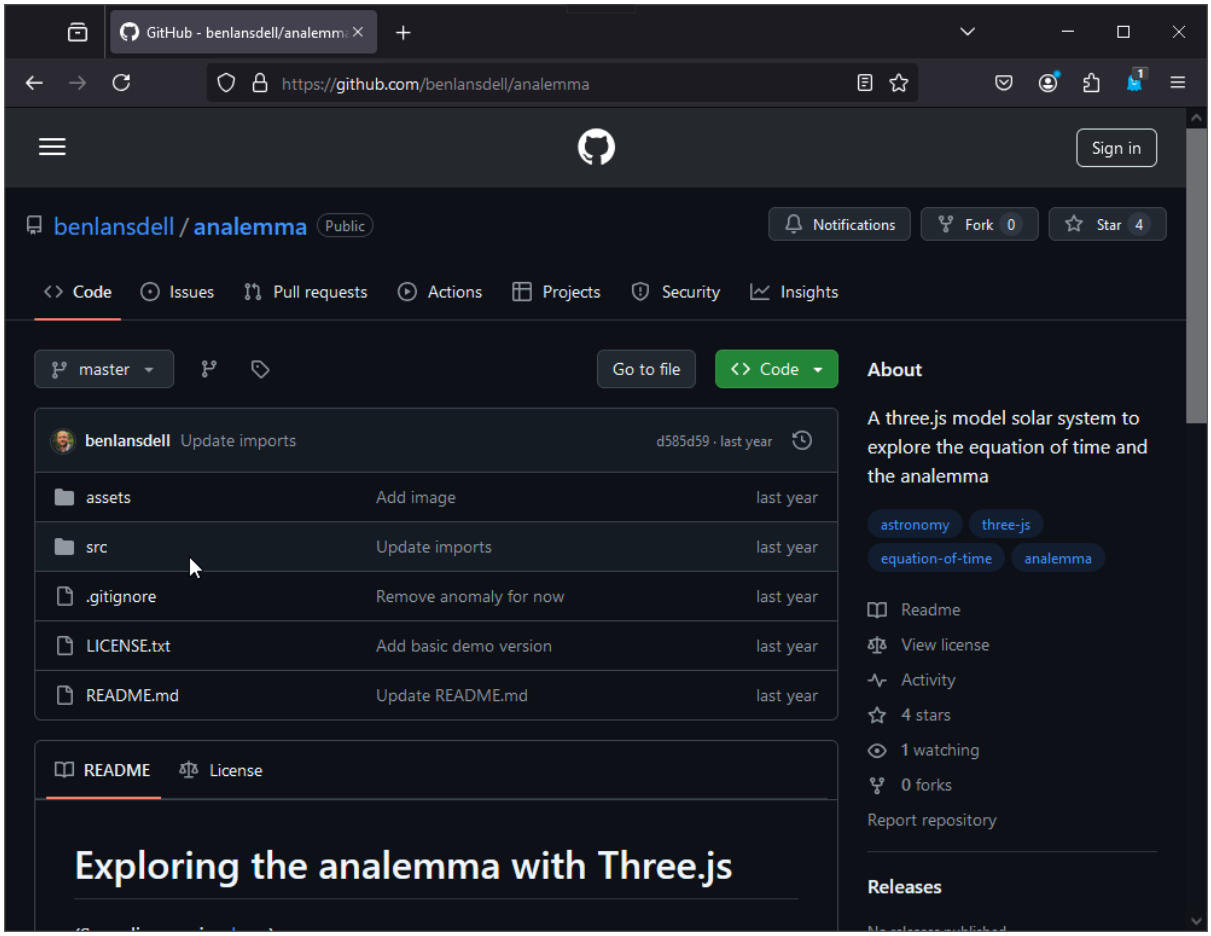
Flat Earth proponents are also unable to provide a computer simulation of the phenomenon, whereas for the globe, this has already been done using JavaScript, which can be explored here with an interactive interface:

https://benlansdell.github.io/analemma



The source code is available here:

https://github.com/benlansdell/analemma



Or here is a Python code to reproduce the theoretical analemma superimposed with a real observed analemma photo (install the ad hoc libraries first by running the command `pip install numpy matplotlib astropy cartopy`):

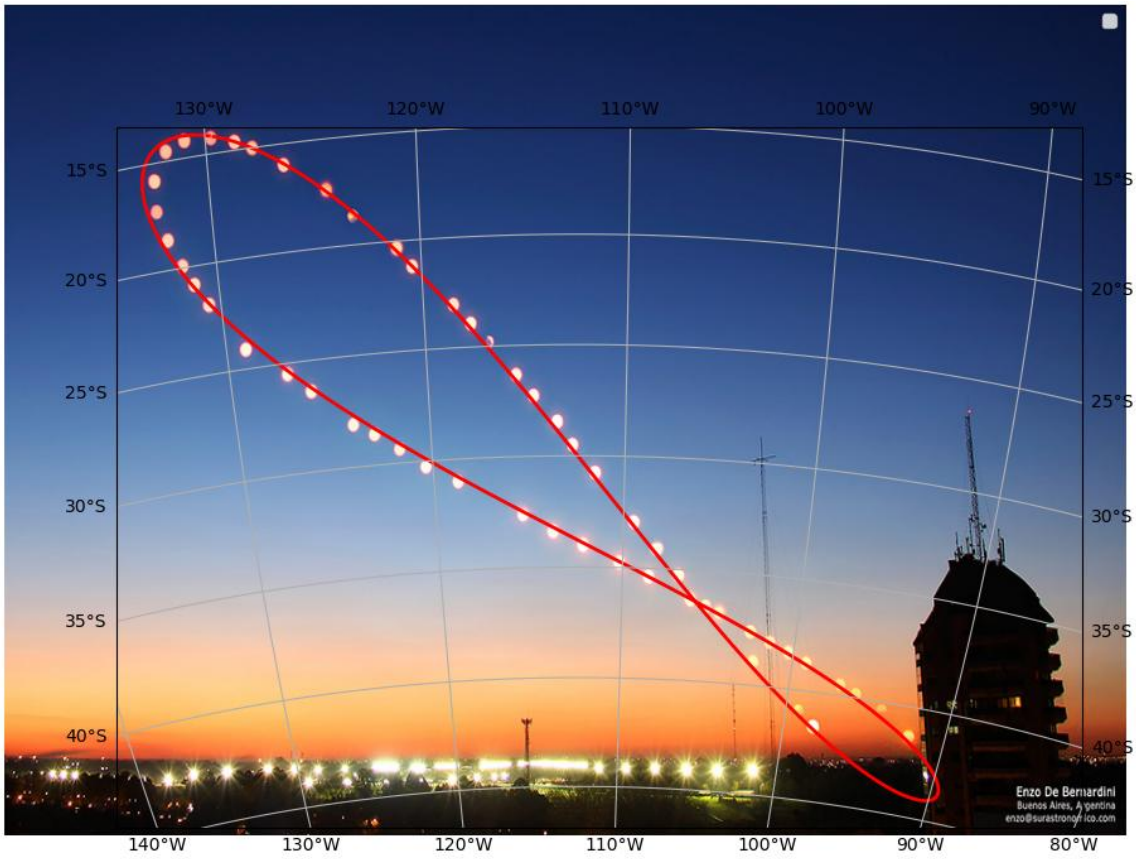
```
import numpy as np
import matplotlib.pyplot as plt
import astropy.units as u
import astropy.time
import astropy.coordinates
import cartopy.crs as ccrs

# Function to define the observation time and location
def loc_time(location, year, month, day, hour):
    # Convert month name (e.g., "Jan") to integer if needed
    if isinstance(month, str):
        month = month.strip()[:3].title()
        months = {"Jan":1, "Feb":2, "Mar":3, "Apr":4, "May":5,
"Jun":6,
                  "Jul":7, "Aug":8, "Sep":9, "Oct":10, "Nov":11,
"Dec":12}
        if month not in months:
            raise ValueError(f"Invalid month name: {month}")
        month = months[month]

    # Format the hour string (e.g., "13:00")
```

```
    hour_str = hour if isinstance(hour, str) else
f"{int(hour):02d}:00"
    time_str = f"{year}-{month:02d}-{day:02d}T{hour_str}"

    # Create a time array covering one year from the input time
    time = astropy.time.Time(time_str) + np.arange(365) * u.day

    # Convert location string to EarthLocation
    location =
astropy.coordinates.EarthLocation.of_address(location)

    # Create the AltAz frame for the full year
    frame = astropy.coordinates.AltAz(obstime=time,
location=location)
    return time, location, frame

# ----------------------------
# PARAMETERS TO CUSTOMIZE
# ----------------------------
Location = "Buenos Aires"                    # Observer's location
year = 2013                                  # Start year
month = "Jan"                                # Start month
day = 12                                     # Start day
hour = "00:28"                               # Local time at start
superposition = True                         # Whether to overlay an
image
image_filename = "Analemma_argentina.jpg"    # Image to overlay (if
exists)

# Get the Sun's position over the year
time, location, frame = loc_time(Location, year, month, day, hour)
sun = astropy.coordinates.get_body("sun",
time=time).transform_to(frame)
alt = sun.alt.deg    # Altitude of the Sun (degrees)
az = sun.az.deg      # Azimuth of the Sun (degrees)

# Use orthographic projection centered on the mean Sun position
projection = ccrs.Orthographic(az.mean(), alt.mean())

# ----------------------------
# PLOT WITH IMAGE OVERLAY
# ----------------------------
if superposition:
    try:
        # Try to read the image file
        img = plt.imread(image_filename)

        # Create the main figure and axis with projection
        fig = plt.figure()
        ax = fig.add_subplot(1, 1, 1, projection=projection,
facecolor='none')

        # Define the extent of the sky view
        buffer_az = 1
```

```
        buffer_alt = 1
        az_min, az_max = az.min() - buffer_az, az.max() + buffer_az
        alt_min, alt_max = alt.min() - buffer_alt, alt.max() +
buffer_alt
        ax.set_extent([az_min, az_max, alt_min, alt_max],
crs=ccrs.PlateCarree())
        ax.set_zorder(1)  # Keep it above background image

        # Get the position and size of the plot for background image
placement
        bbox = ax.get_position()
        left, bottom, width, height = bbox.x0, bbox.y0, bbox.width,
bbox.height

        # Adjust background image size and offset
        offset_left = 0.09
        offset_bottom = 0
        zoom_factor = 1.16

        # Add image as background
        ax_img = fig.add_axes([
            left - offset_left,
            bottom - offset_bottom,
            width * zoom_factor,
            height * zoom_factor
        ], frameon=False)
        ax_img.imshow(img, aspect='auto')
        ax_img.set_xticks([])
        ax_img.set_yticks([])
        ax_img.set_zorder(0)  # Draw behind the plot

        # Plot the Sun path on top of the image
        ax.plot(az, alt, transform=ccrs.PlateCarree(), color="red",
linewidth=2, label="Sun path")
        ax.gridlines(draw_labels=True)
        plt.title(f"Apparent Path of the Sun (Seen from
{Location})")
        plt.legend()
        plt.show()

    except FileNotFoundError:
        # If the image file is missing, only print a message (no
plot)
        print("⚠ Image not found.")

# ----------------------------
# PLOT WITHOUT IMAGE OVERLAY
# ----------------------------
else:
    # Create figure and sky plot
    fig = plt.figure()
    ax = fig.add_subplot(1, 1, 1, projection=projection,
facecolor='none')
    ax.plot(az, alt, transform=ccrs.PlateCarree(), color="red",
```

```
linewidth=2, label="Sun path")
    ax.gridlines(draw_labels=True)
    plt.title(f"Apparent Path of the Sun (Seen from {Location})")
    plt.legend()
    plt.show()
```

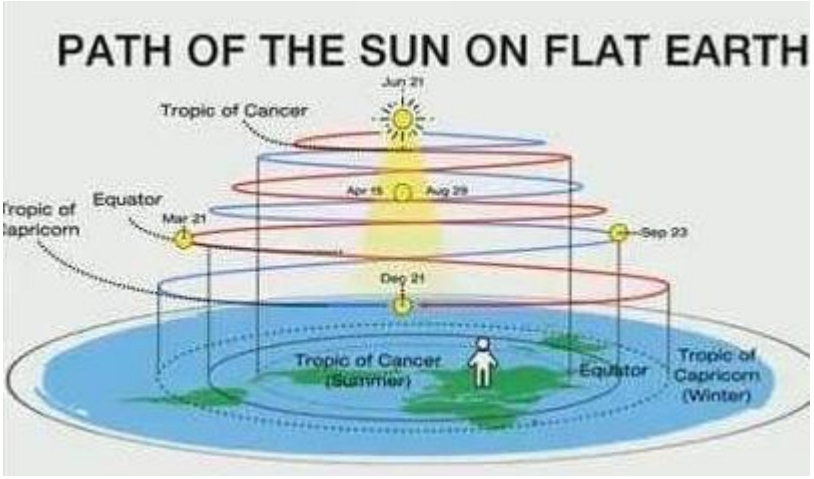
Below is the result of the Python theoretical model overlayed with observed reality:



We expect the flat-Earthers to do better with their hypothesis!

Some proponents of the flat Earth twist all the laws of physics by explaining the analemma with the following diagram:

translation



But this configuration poses several problems:

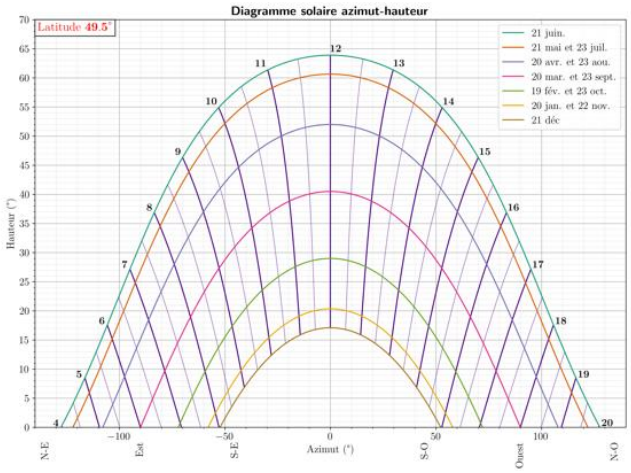
- It violates Newton's laws
- It violates the principle of conservation of energy
- It violates the principle of conservation of momentum
- It violates the principle of conservation of angular momentum
- It violates observations of the Sun's angular diameter
- It violates Huygens' principle of light propagation
- It violates observations of seasonal temperature variations
- It violates General Relativity
- It violates Newton's theory of gravity
- Etc.

In short… flat-Earthers cannot explain the analemma without violating absolutely all of reality and all the laws of physics!

translation into english ongoing

(#143) Shape of the apparent path of the Sun (solargraph)

On a flat Earth, the orthogonal projections of the Sun's orbits would be circles (or arcs of circles). In reality, however, we observe more complex shapes:



Here is another visual representation of the orthogonal projections of the Sun's trajectories:

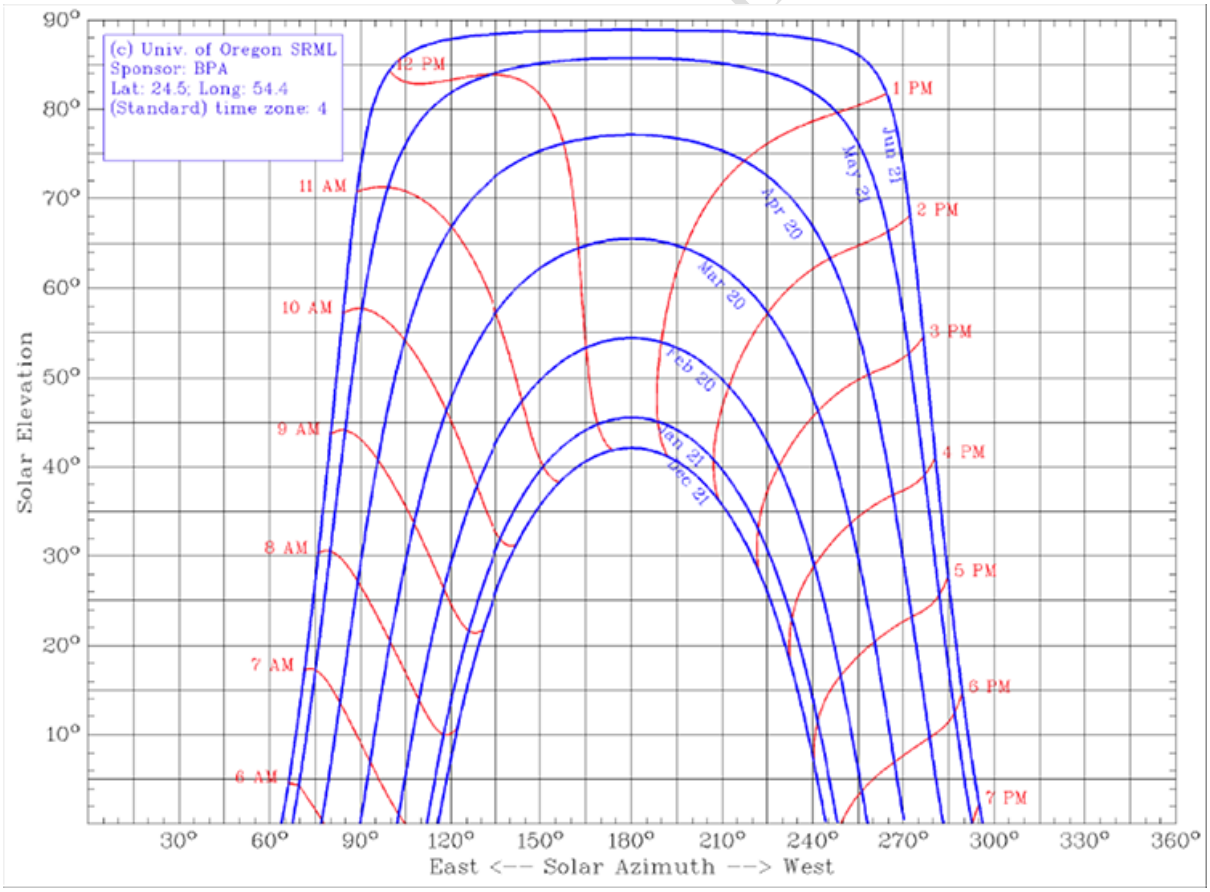


Figure 76 The orthogonal projection of the solar trajectory for the location (re-edited: (Abu Dhabi, 24.5° N, 54.4° W) obtained by the Sun Chart calculator [UK SML, 2007])

Based on actual observations captured using a pinhole camera made from a beer can lined with photographic paper, the image below shows sunrises and sunsets over an eight-year period (2,953 sunrises and sunsets) from the University of Hertfordshire's Bayfordbury Observatory between 2012 and 2020:

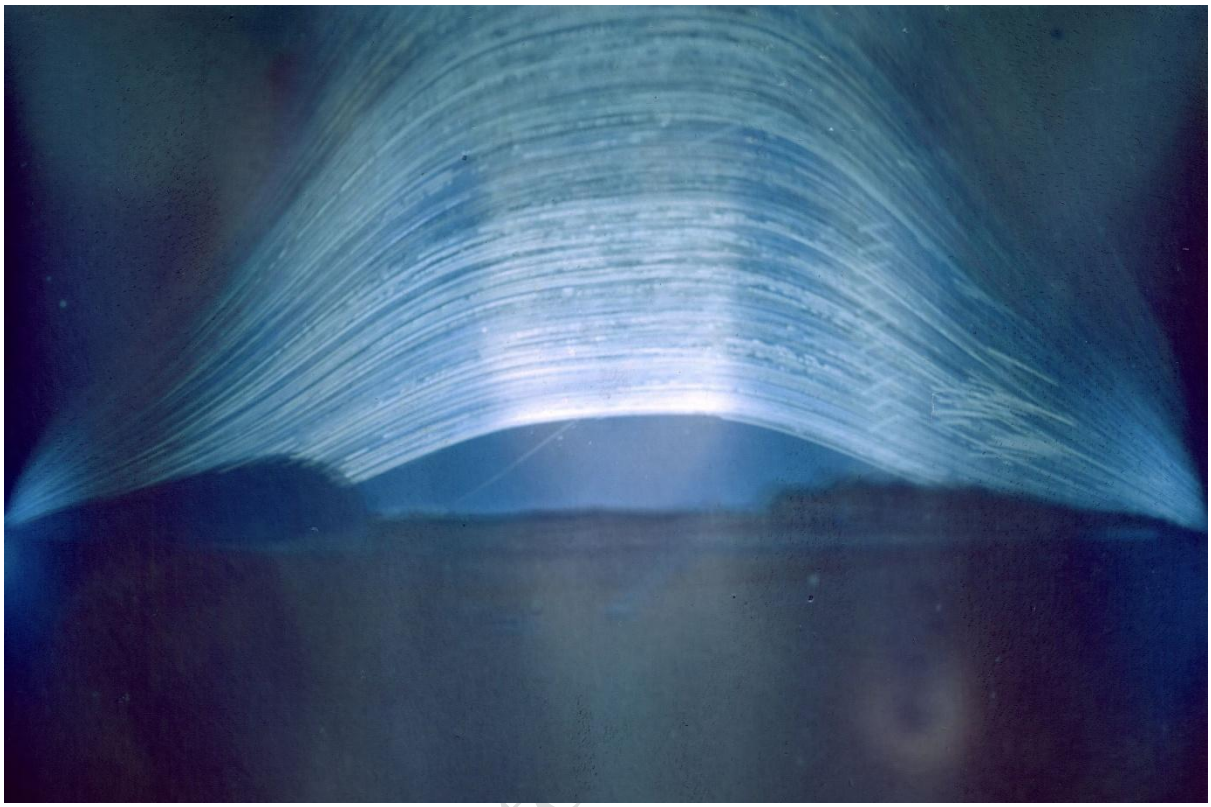
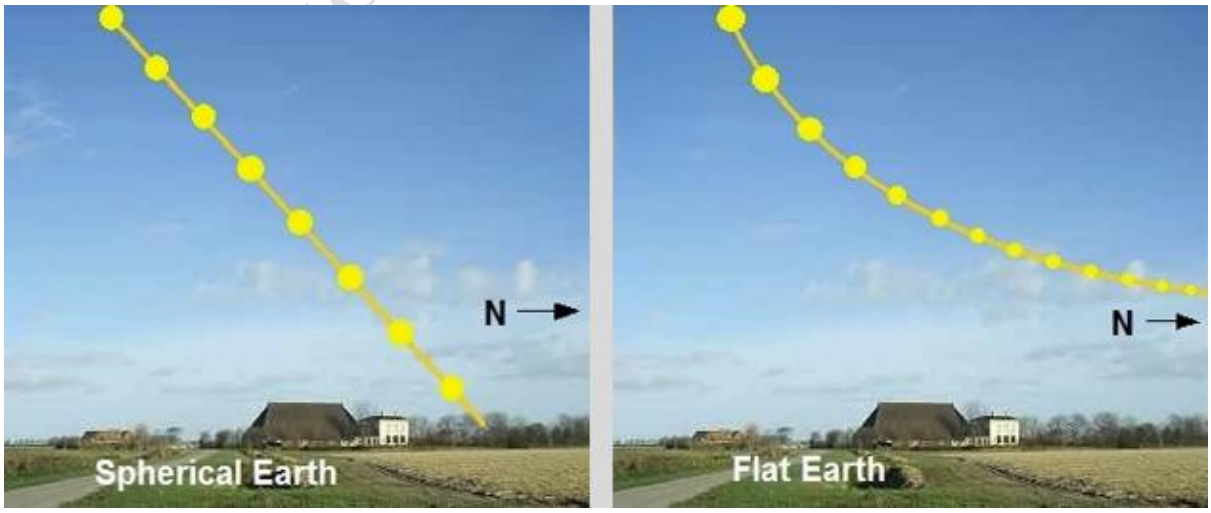


Figure 77 Apparent path of the sun (photo: Regina Valkenborgh)

The picture below on the left shows the way the Sun actually sets. The angle depends on your latitude. The picture on the right shows how the Sun would appear to "set" in the "modern" flat Earth hypothesis. The positions of the Sun in both pictures represent equal intervals of time.



Notice how the flat Earth hypothesis shows the Sun getting smaller as it recedes because of the law of linear perspective, and how the spacing between positions decreases with distance. This is how linear perspective actually works!

translation into english ongoing

(#144) Angle of displacement/Apparent rotation of the Sun

In the Northern Hemisphere, the Sun appears to move to the right (clockwise). In the Southern Hemisphere, it appears to move to the left (counterclockwise). At (apparents !) sunrise and sunset, the Sun's path forms an angle that roughly corresponds to the observer's latitude. This phenomenon occurs because observers located at different points on the Earth's surface are not on the same plane!

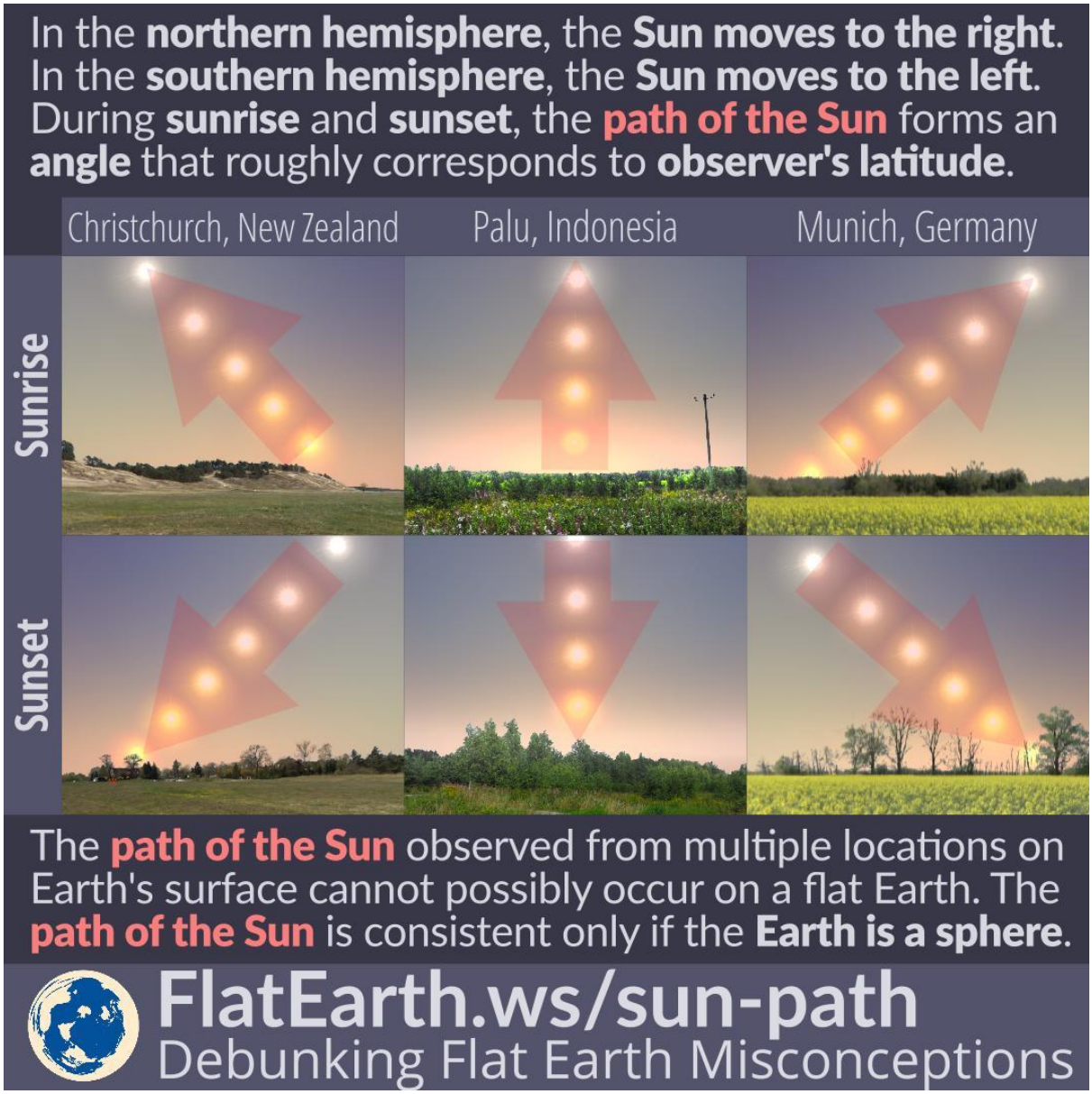

In the northern hemisphere, the Sun moves to the right.
In the southern hemisphere, the Sun moves to the left.
During sunrise and sunset, the path of the Sun forms an angle that roughly corresponds to observer's latitude.
Christchurch, New Zealand
Palu, Indonesia
Munich, Germany
Sunrise
Sunset
The path of the Sun observed from multiple locations on Earth's surface cannot possibly occur on a flat Earth. The path of the Sun is consistent only if the Earth is a sphere.
FlatEarth.ws/sun-path
Debunking Flat Earth Misconceptions

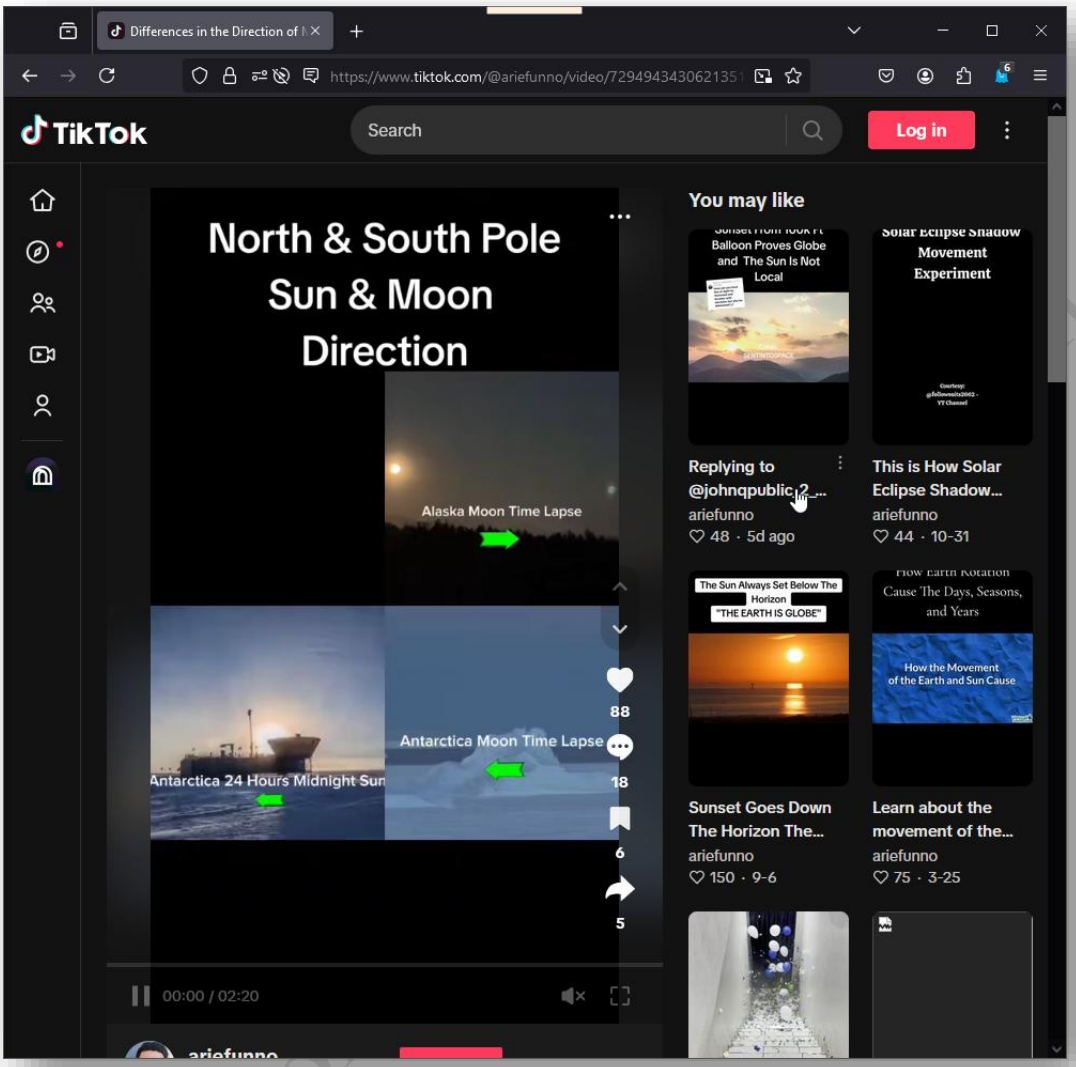
Figure 78 Apparent movements of the Sun (source : https://flatearth.ws/t/sun-path)

The path of the Sun observed from many different locations on the Earth's surface is proof that the Earth is spherical. This observation cannot occur on a flat Earth!

Note: Flat Earth proponents do not understand the concept of rotation direction relative to the center of curvature. They confuse left-right/left-right with the concept of rotation direction…

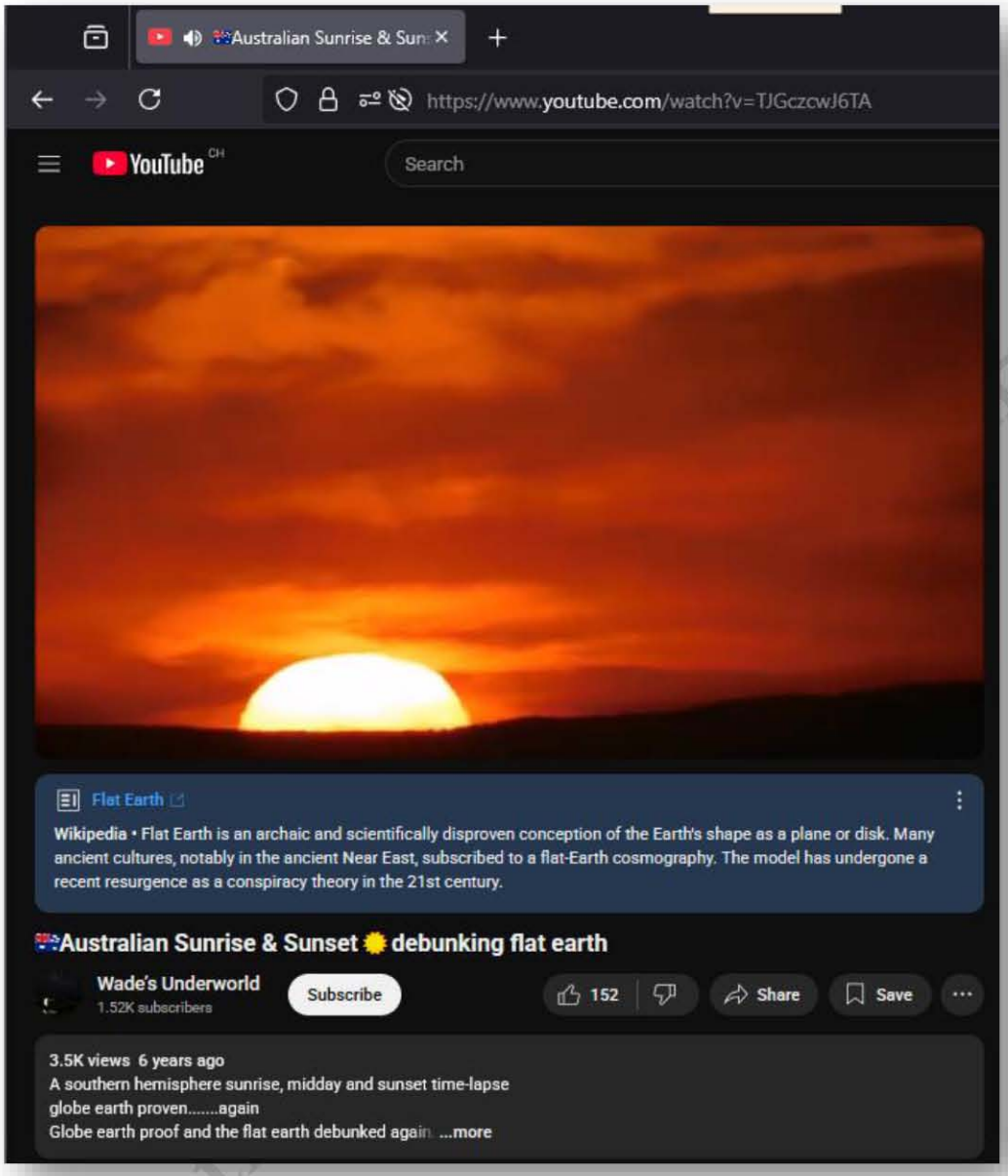
For those who prefer to watch a video rather than the illustration above:

https://vm.tiktok.com/ZGdNBE2DL



Or, for those who would like a detailed on-the-ground analysis of the direction of sunset in the Southern Hemisphere, particularly in Australia, we recommend the following excellent video on YouTube:

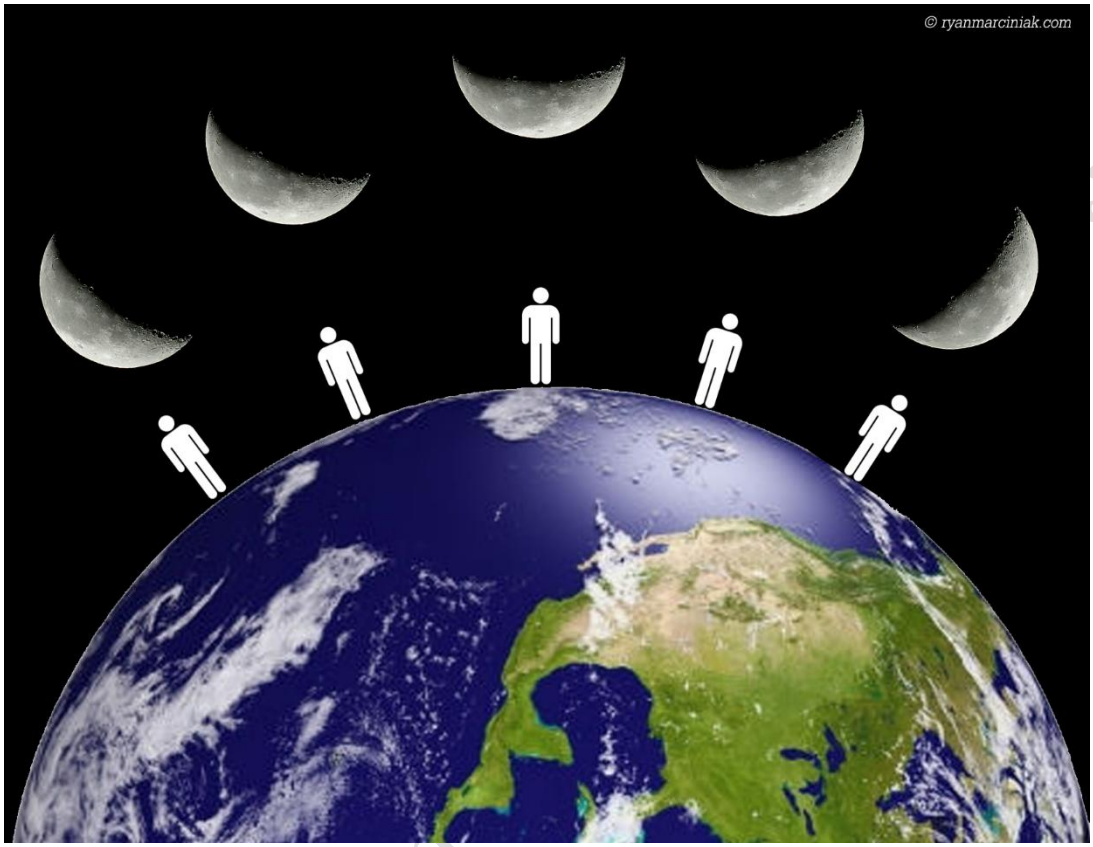
https://www.youtube.com/watch?v=TJGczcwJ6TA


Australian Sunrise & Sun
https://www.youtube.com/watch?v=TJGczcwJ6TA
YouTube CH
Search
Flat Earth
Wikipedia • Flat Earth is an archaic and scientifically disproven conception of the Earth's shape as a plane or disk. Many ancient cultures, notably in the ancient Near East, subscribed to a flat-Earth cosmography. The model has undergone a recent resurgence as a conspiracy theory in the 21st century.
Australian Sunrise & Sunset debunking flat earth
Wade's Underworld
1.52K subscribers
Subscribe
152
Share
Save
3.5K views 6 years ago
A southern hemisphere sunrise, midday and sunset time-lapse
globe earth proven.....again
Globe earth proof and the flat earth debunked again ...more

translation

(#145) Sunspot orientation

Similarly, as we will see later on page 422, the angles of the phases of the Moon change with latitude (which is impossible on a flat Earth):

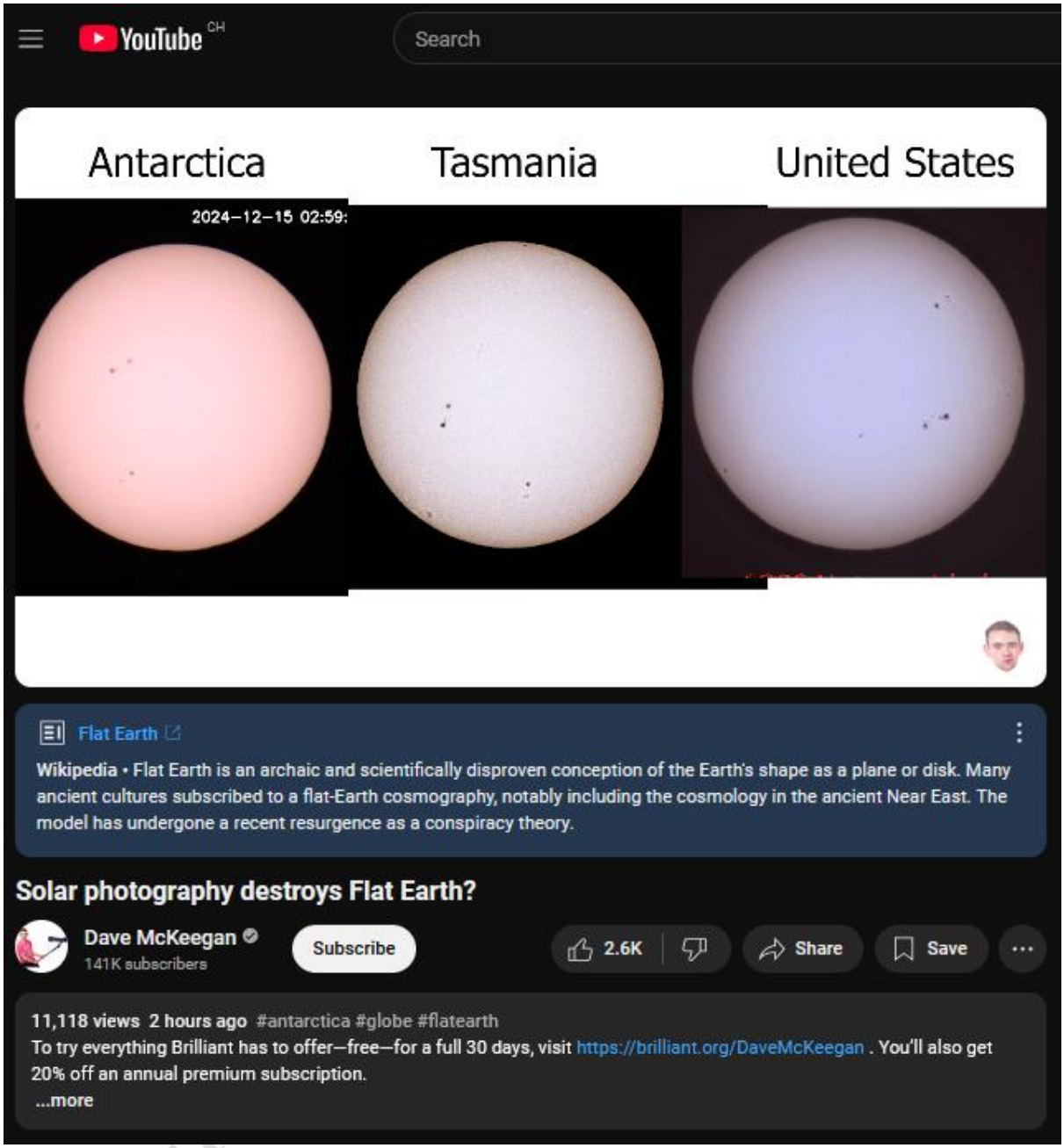


we can observe a phenomenon on the Sun which also confirms that we are on a globe, and that is sunspots!

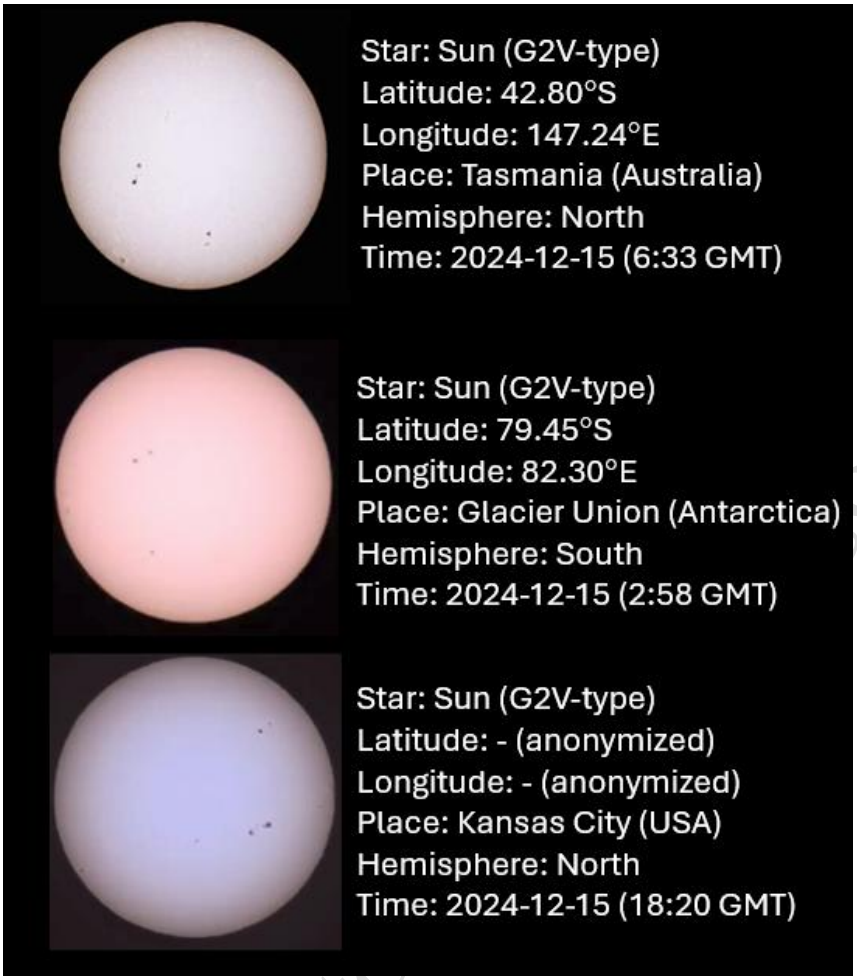
Participants of "The Final Experiment" (see page 659) and several astronomy enthusiasts took advantage of this event to take several photos of the Sun, as explained in the video available through the following link:

https://www.youtube.com/watch?v=eYm6q8JY7Hk

translation in


YouTube CH
Search
Antarctica
Tasmania
United States
2024-12-15 02:59:
Flat Earth
Wikipedia • Flat Earth is an archaic and scientifically disproven conception of the Earth's shape as a plane or disk. Many ancient cultures subscribed to a flat-Earth cosmography, notably including the cosmology in the ancient Near East. The model has undergone a recent resurgence as a conspiracy theory.
Solar photography destroys Flat Earth?
Dave McKeegan
141K subscribers
Subscribe
2.6K
Share
Save
11,118 views 2 hours ago #antarctica #globe #flatearth
To try everything Brilliant has to offer—free—for a full 30 days, visit https://brilliant.org/DaveMcKeegan . You'll also get 20% off an annual premium subscription.
...more

the same day, and this gives us the following photos:



The comparison leads to an immediate conclusion: the Earth cannot be flat, whether relative to the angle of sunspots or the angular size of the Sun itself! In all likelihood, the Earth is therefore not flat!

translation into

(#146) Position of (apparent) sunrise/sunset

Many people are surprised to learn that the Sun doesn't usually rise in the East and set in the West. This only happens at the equinoxes (the day of the year when day and night are of equal length). At this time of year, the Sun rises due south of the East and sets due south of the West. And this is where another problem lies for proponents of the flat Earth hypothesis!

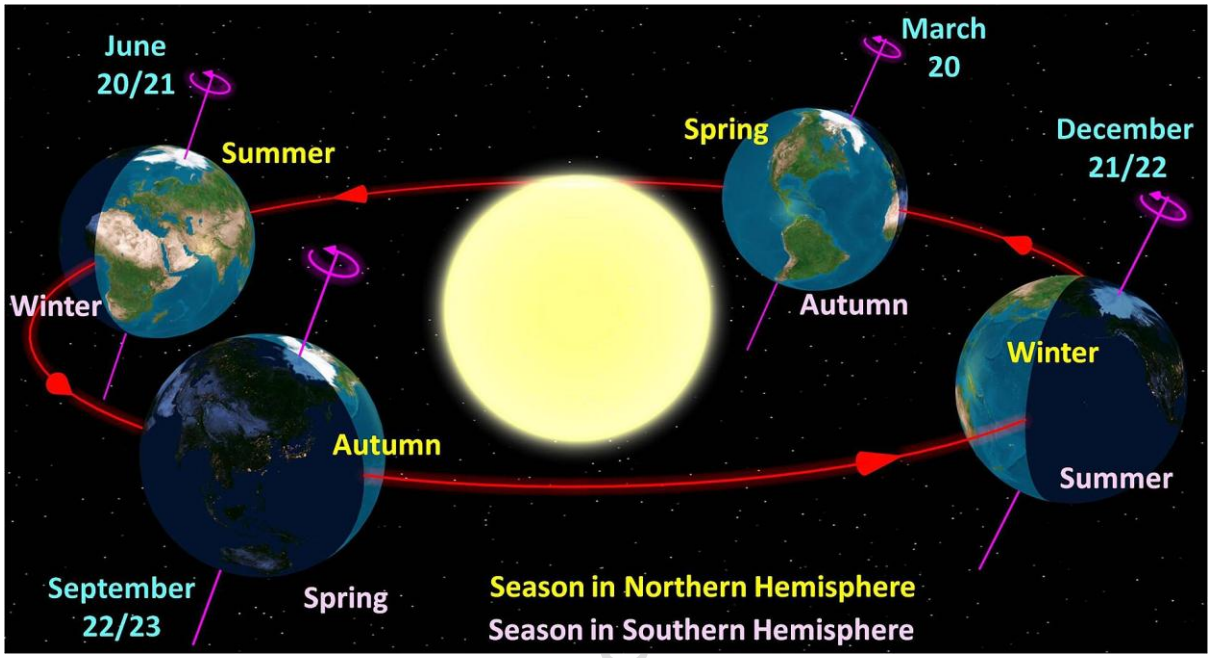
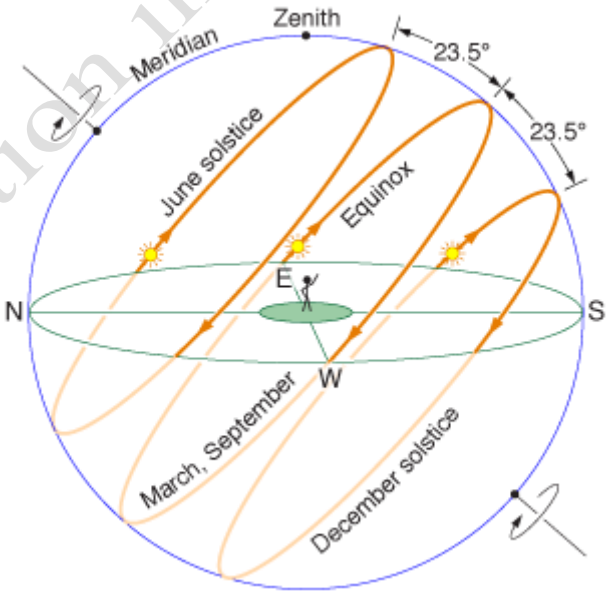


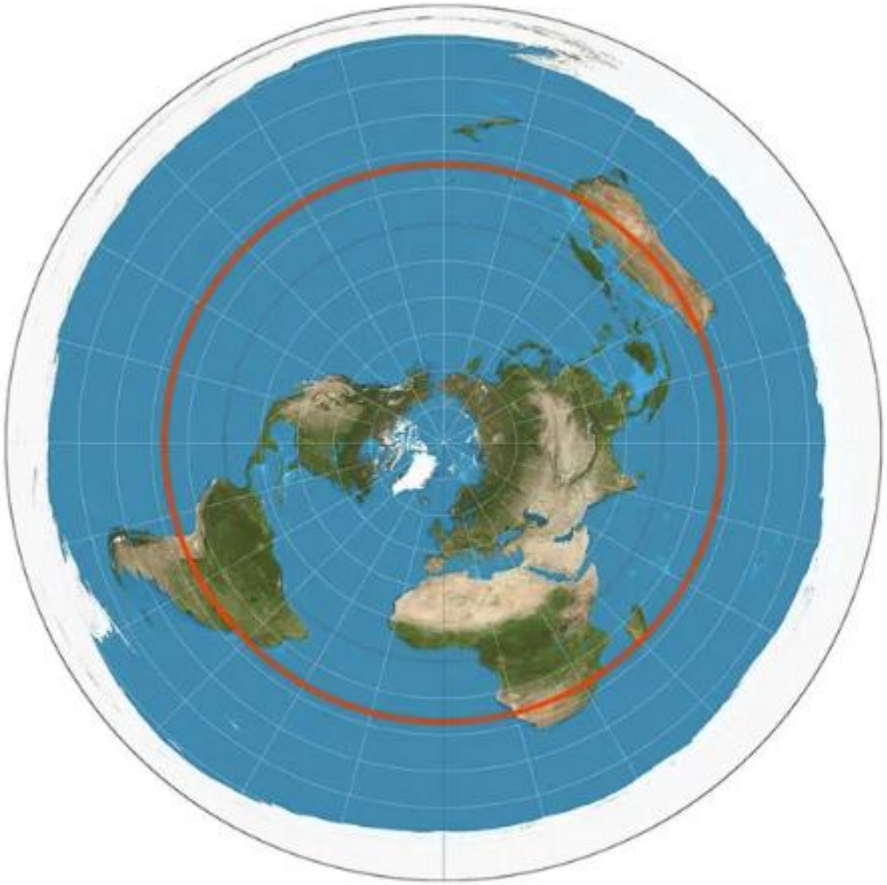
Figure 79 Equinoxes (source : Wikipédia, auteur : Tau'olunga)

Or another illustration in a different style than the one above, if that can help:



Why is this a problem? Proponents of the flat Earth theory believe in the so-called "zetetic" model. The figure below shows the Earth's surface according to the "zetetic" model:

translation into



The North Pole is at the center. There is no South Pole, nor is there an Antarctic continent. On the contrary, the flat, round Earth is surrounded by a wall of ice that we usually call Antarctica. Proponents of the flat Earth hypothesis don't know how far the Antarctic ice desert extends, and they don't care. You see, the bottom of the dome of the sky to which the stars are attached (the firmament of the King James Bible…) lies somewhere beyond the wall of ice. Proponents of the flat Earth theory believe that no one can penetrate the dome, so it would be pointless to speculate about where the Antarctic ice ends. In the zetetic model, the Sun rotates above the Earth each day around an axis passing through the North Pole. The radial distance between the North Pole and the Sun changes throughout the year (obviously violating most of the laws of conservation of physics in the process…), with the radius being smallest at the June solstice and largest at the December equinox. For proponents of the flat Earth theory, this spiraling distance explains in their imagination the changes that occur throughout the year, such as seasonal temperature differences and the amount of sunlight received daily.

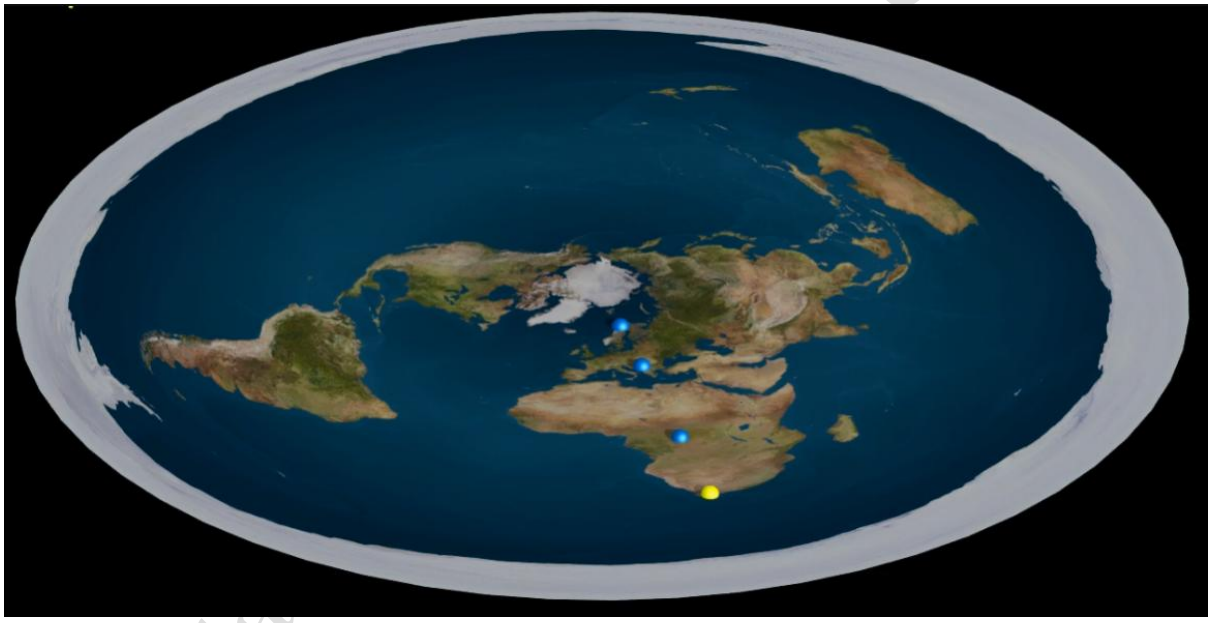
On the map above, we have placed a red circle along the Tropic of Capricorn. This circle represents where the Sun is directly overhead at noon on the December solstice. In the zetetic model, the circle also represents the circumference of the Sun's movement on that day (albeit at an unspecified height above the flat Earth…). Choose a location beyond this circle, for example, in southern South America, southern Africa, or southern Australia. Note that the Sun will be north of all these locations at the December solstice. In fact, since the Sun is at its southernmost point on this date, it will always be north of these locations. It is true that at noon, the Sun will be due north at each of these locations, casting shadows that extend due south. Also note that before noon, the Sun will be in the northeast, and after noon, it will be in the

northwest. So how can the Sun rise in the South of the East and set in the South of the West in these locations? Obviously, it's not possible!

On the other hand, the observed direction of sunrise and sunset throughout the year is what we would expect on a spherical Earth that orbits the Sun annually and rotates on its axis with a tilt of 23.4° relative to its axis of revolution (conventional cosmology). Between the March and September equinoxes, the Northern Hemisphere is tilted towards the Sun, allowing sunlight to reach the northern parts of the Earth. This is why sunrise is in the Northeast and sunset in the Northwest worldwide at this time. Conversely, between the September and March equinoxes, the Southern Hemisphere is tilted towards the Sun, allowing sunlight to reach the southern parts of the Earth, and causing the Sun to rise in the Southeast and set in the Southwest.

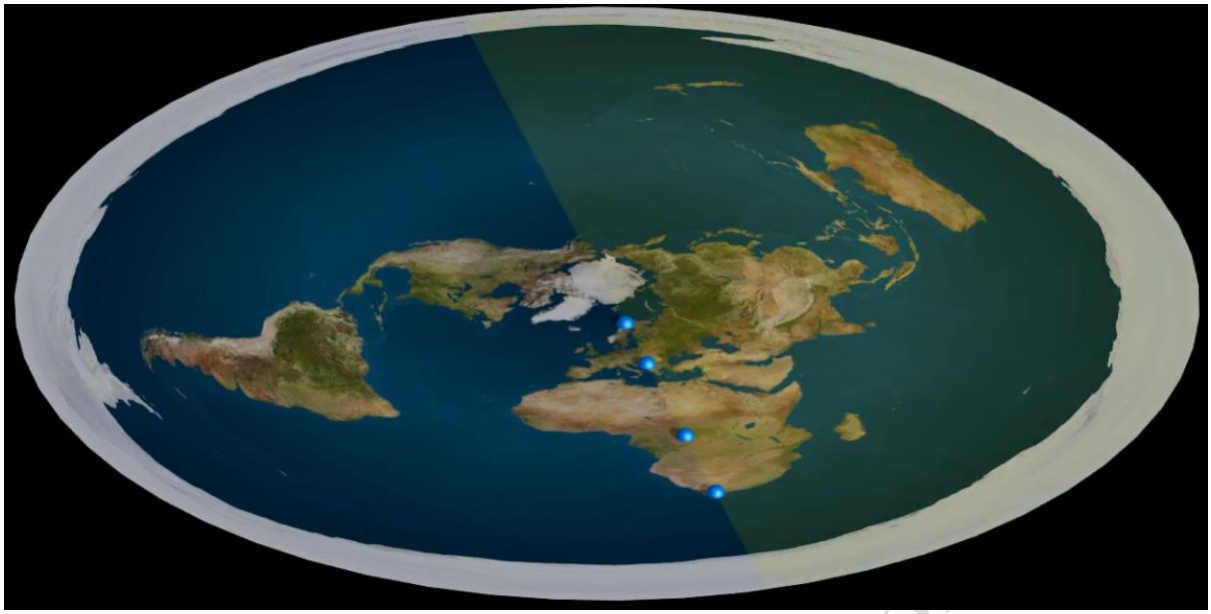
To better understand, let's illustrate with the computer-generated images created by Jos Leys (source:https://www.youtube.com/watch?v=7nzEhDX-xzg).

We take four cities (Setermoen in Norway, Sarajevo in Bosnia, Mbandaka in Congo and Cape Town in South Africa):

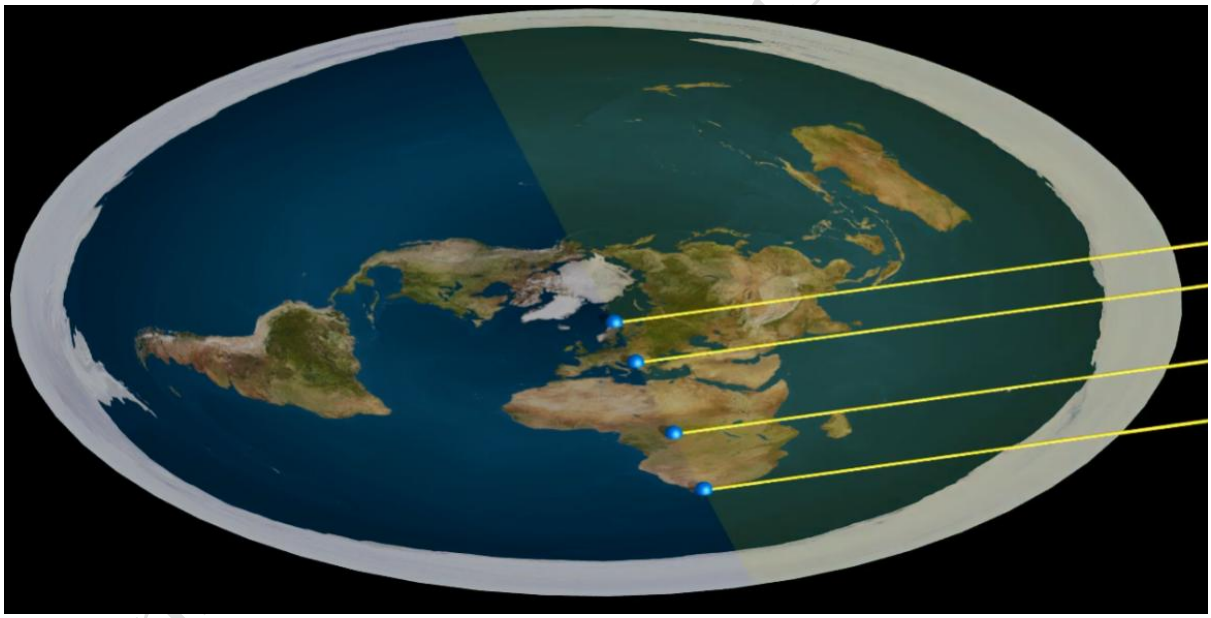


At the spring equinox, on March 20th, the following part of the Earth is illuminated:

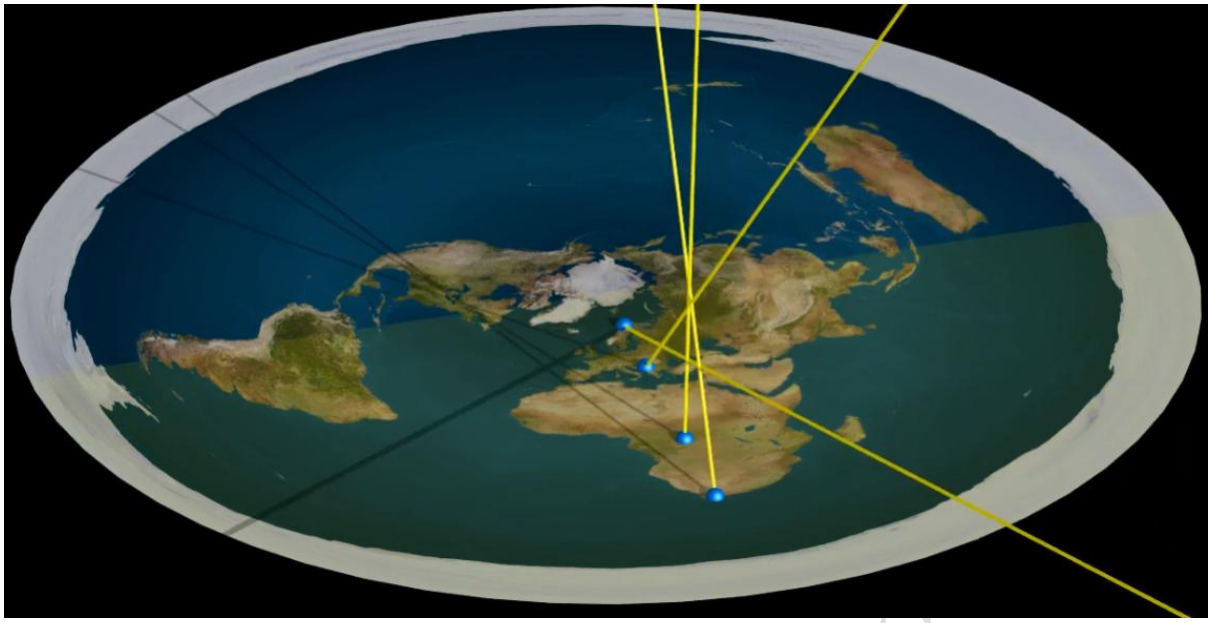
translation ongoing



In the real world, the yellow lines visible below represent the orientation of light rays or observation points towards the direction of the Sun at sunrise:

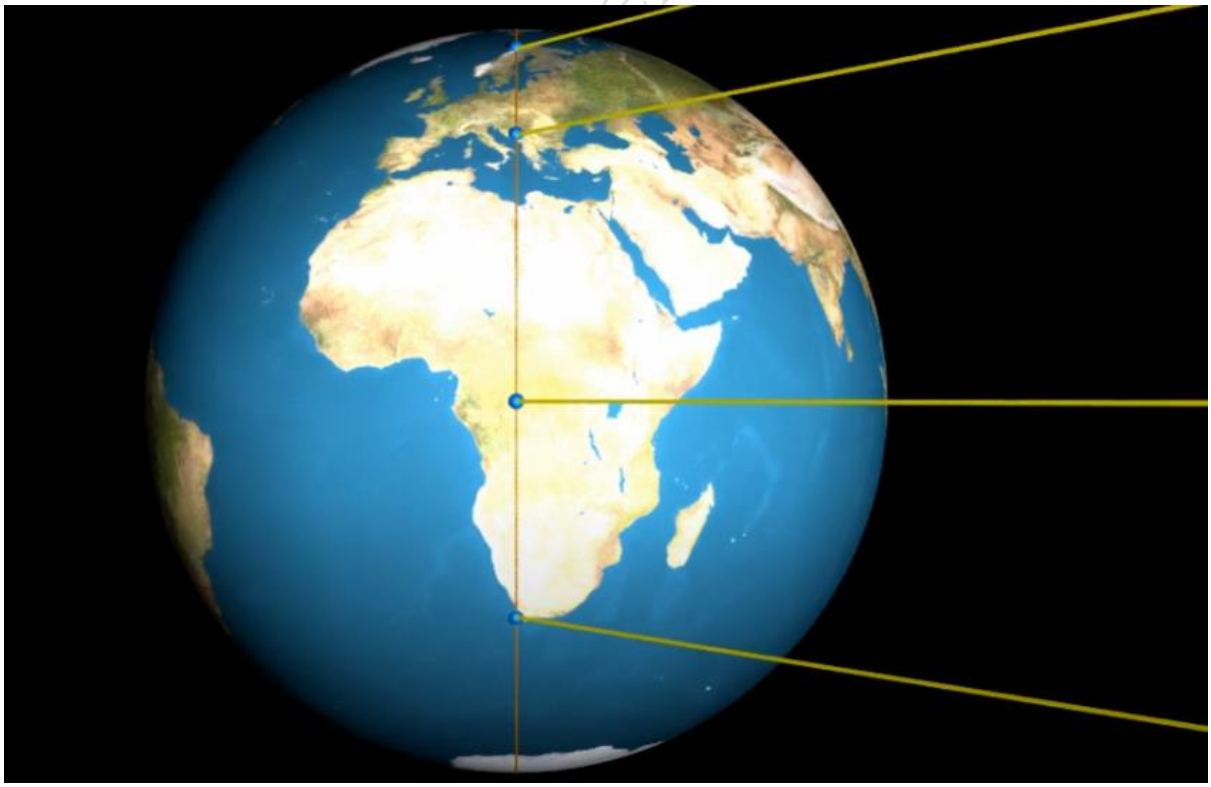


On a flat Earth, the position of the Sun projected into this paradigm gives, for example, at noon:



So for each of the 4 cities, the Sun is not at the same place! Obviously some proponents of the flat Earth claim that at the equinoxes there are four different Suns because of the seven domes that reflect the light of the Sun, obviously all this without being able to prove it empirically, nor to model it…

On a globe with a very distant Sun, this is obviously not a problem:



An immediate consequence is that the angle between the celestial North Pole and the maximum elevation of the Sun at equinox is a constant of 90° for all points north of the equator (to simplify: all the points along a meridian from N0° to N90°).

(#147) Sun Tracker

The instrument presented below is intended as an educational tool that allows you to find, for a given latitude and date, the time of sunrise and sunset, and therefore the length of the day:

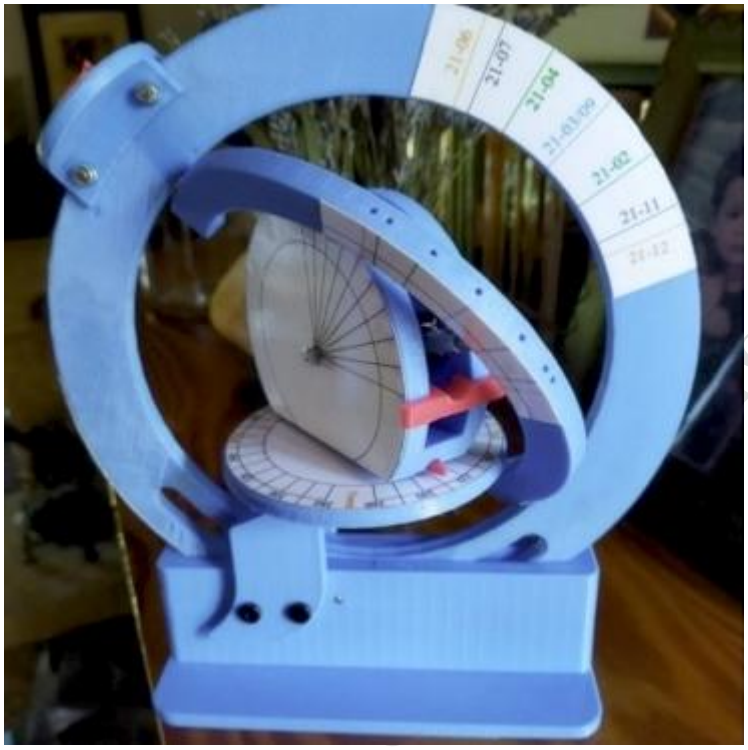


Figure 80 Sun Tracker

It allows us to indicate the culmination height of the Sun, the combined height of the Sun and its azimuth for any time of day, allowing us to emphasize that the Sun does not rise every day of the year in the East and that it does not always set in the West, or that the Sun does not necessarily culminate at the zenith but that its maximum height on the horizon is a function of the latitude of a place.

As proved in detail in (Opera Magistris, 2024), this Sun Tracker can only work on the assumption of a globe and is given by the equation:

$$t_{\text{day}}(\delta,\lambda) = 24 + \frac{-2\arccos\left(\tan(\lambda)\tan\left(\arcsin\left(\sin(23°27')\sin(\delta)\right)\right)\right)\cdot 24}{360}$$

This instrument was made jointly by Joël and Laurent Souchu.

translation into English ongoing

Laurent SOUCHU **Joël SOUCHU**

members of Gironde 33 Astronomy

translation into english ongoing

Solstices

For reminder, the solstices are key moments in Earth's annual cycle, marking the points where the Sun reaches its maximum tilt relative to the celestial equator. They occur (at least actually…) twice a year: around June 21 (summer solstice in the Northern Hemisphere) and December 21 (winter solstice in the same hemisphere). At the summer solstice, the Sun reaches its highest point in the sky, providing the longest day of the year, while the winter solstice marks its lowest point, resulting in the longest night. These phenomena result from the tilt of Earth's axis and its revolution around the Sun, influencing the seasons and variations in daylight.

Summer solstice

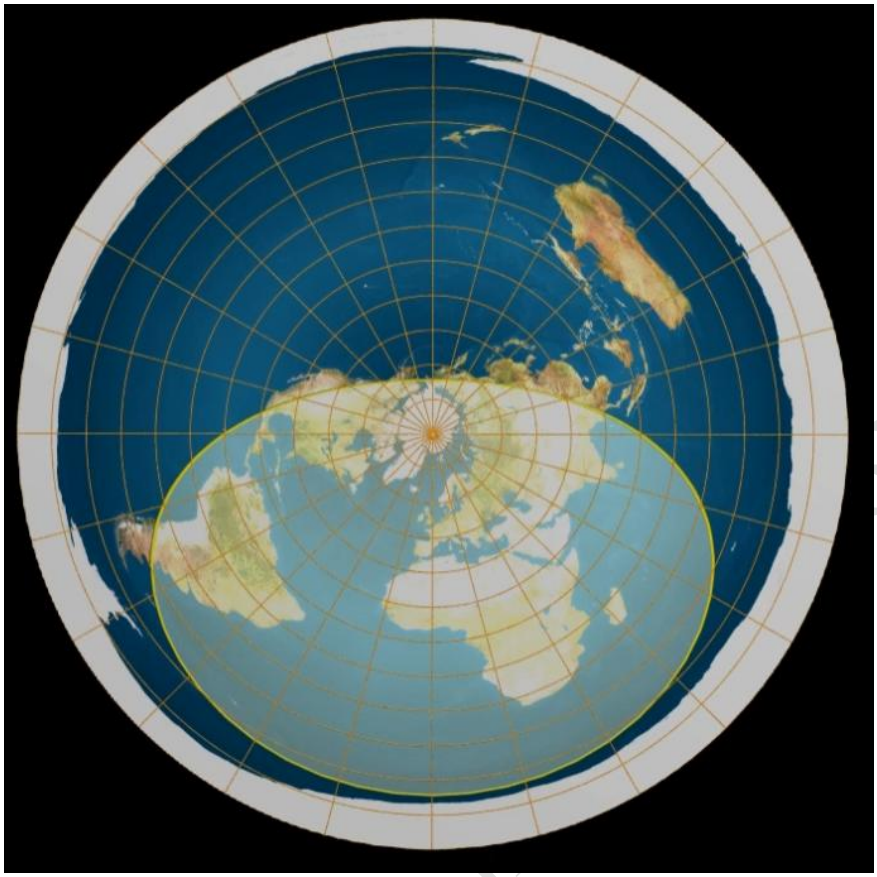
The summer solstice, which occurs around June 21 in the Northern Hemisphere, marks the moment when the Sun reaches its highest point in the sky, thanks to the tilt of the Earth's axis. This day is the longest of the year, offering the maximum number of daylight hours, and it heralds the beginning of astronomical summer. At this time, the Sun's rays strike the Tropic of Cancer perpendicularly, making for exceptionally hot and bright days in many regions. This phenomenon, celebrated for millennia in various cultures, is a direct result of the actual Earth's 23.5° tilt relative to its orbit around the Sun.

(#148) Impossible position of the Sun

The explanations and illustrations that follow are inspired by and taken from Jos Leys (see his YouTube video here: https://www.youtube.com/watch?v=5HgFT9Yu0JY).

Here is a map of the flat Earth at the summer solstice:

translation into english ongoing

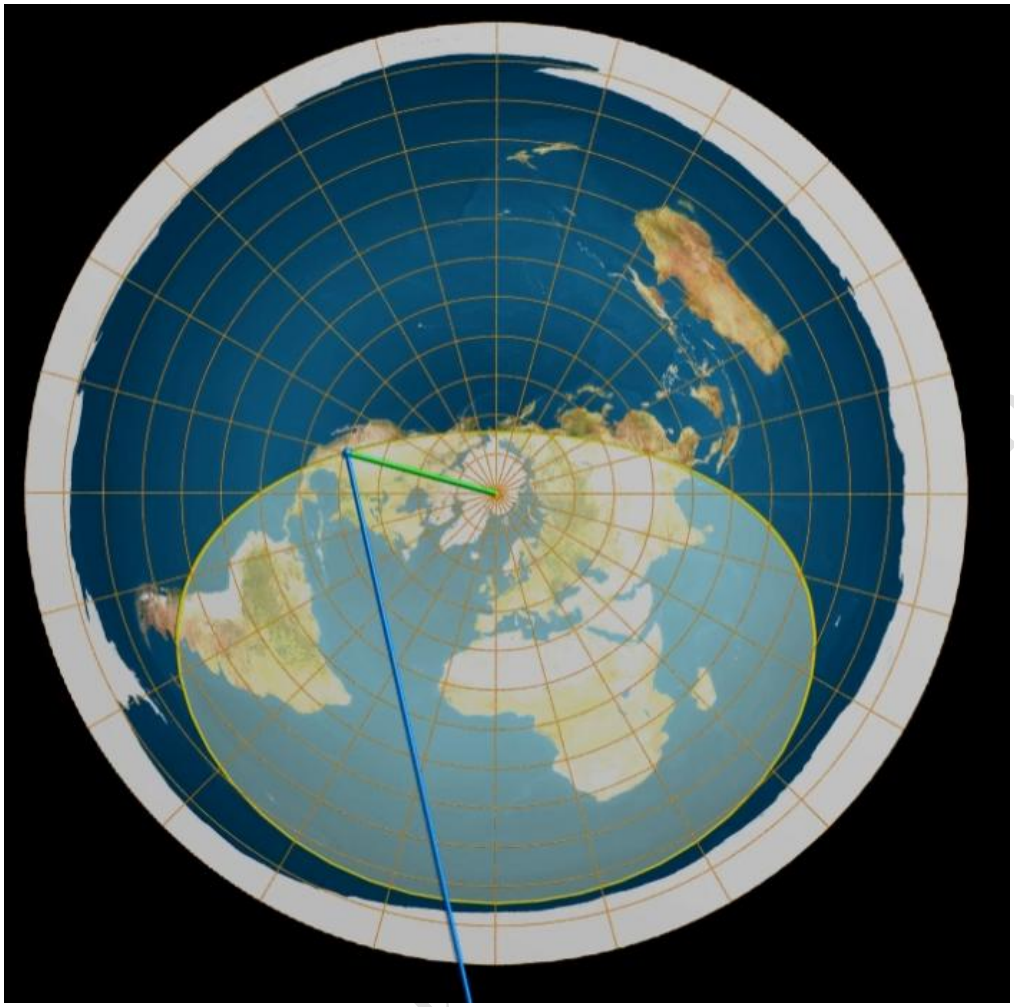


Observe the distribution of daylight! You can verify this by consulting the hours of sunlight on Earth.

Let's choose a specific latitude. The direction of the Sun at sunrise is the same for all locations at that latitude at the time of the summer solstice. The same is true for sunset!

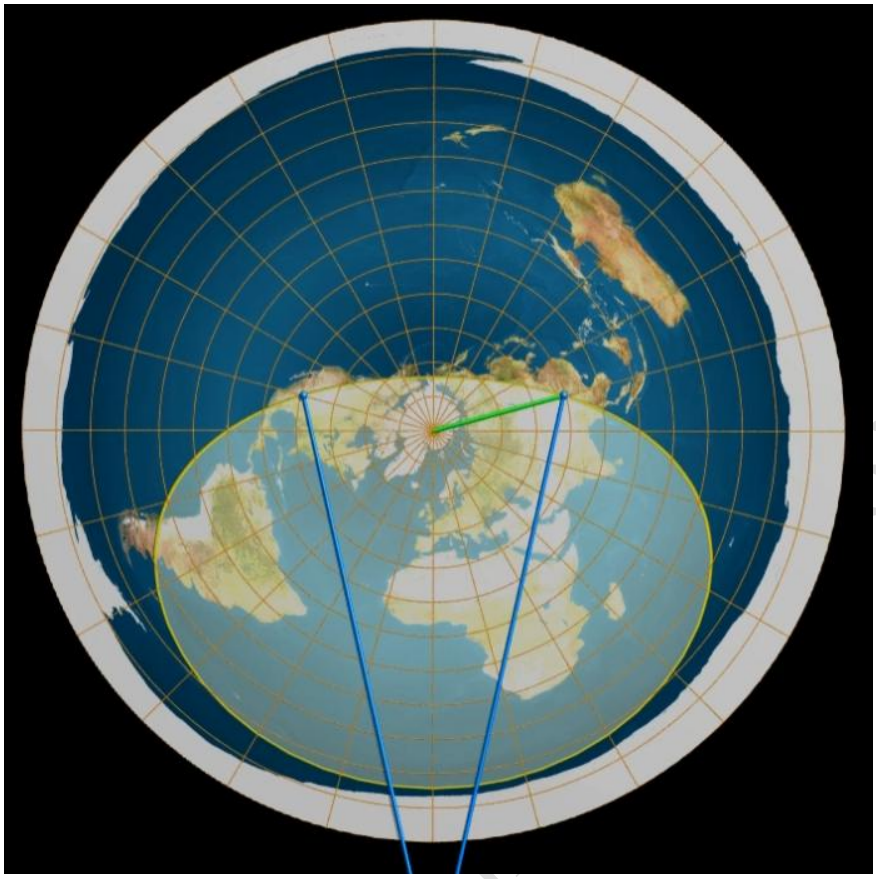
At latitude 30°, the sunrise is at a heading of 62°. The angle between the blue and green lines:

translation into en ing



At latitude 30°, sunset is at a heading of 298°, or -62°, the angle between the blue and green lines:

translation in

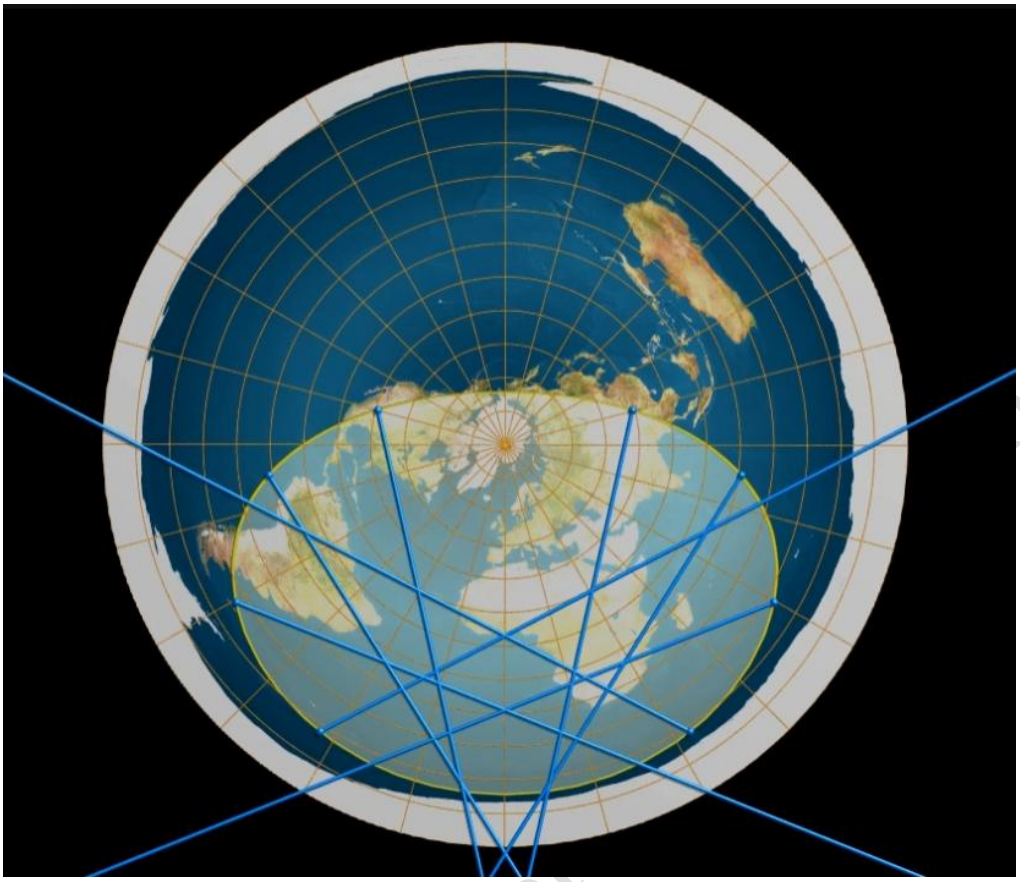


These angles can be checked on the following website, for example (and their accuracy can be easily verified using your own location):

https://www.timeanddate.com

Let's look at more places at different latitudes:

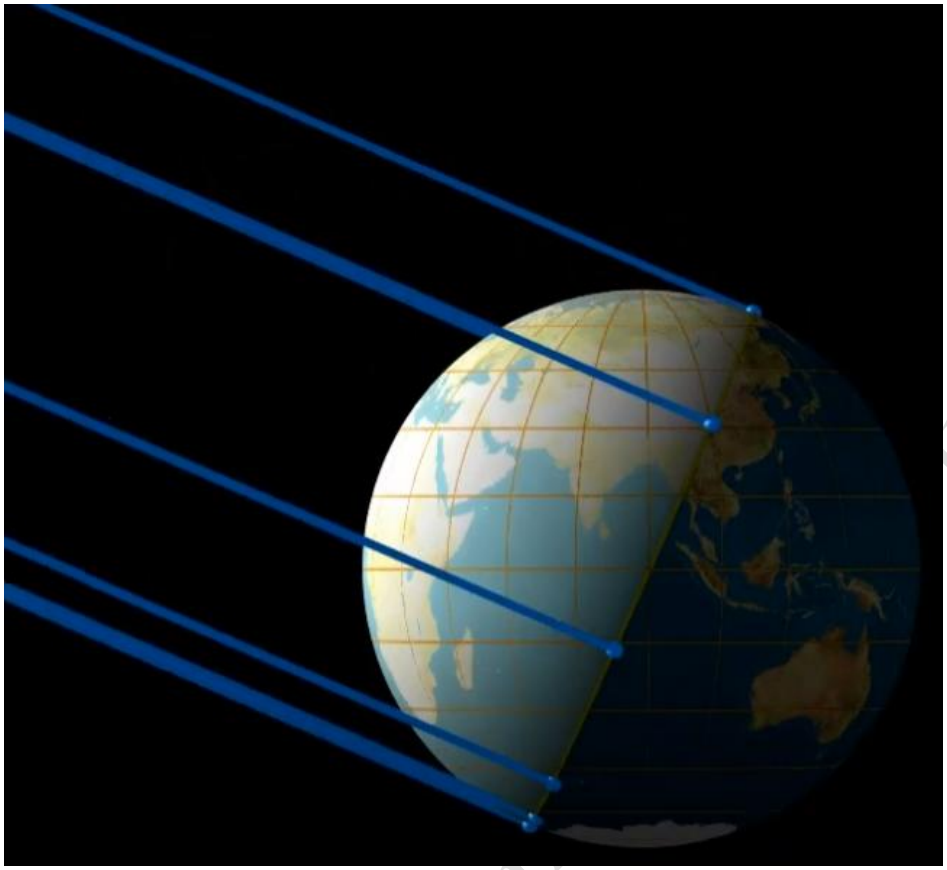
translation into en ing



So… where is the Sun actually on this flat Earth since the direction vectors don't converge at a single point?! Is it a quantum Sun that can be in multiple places at the same time?????

Whereas on a globe the explanation is natural:

translation into en



translation into en ng

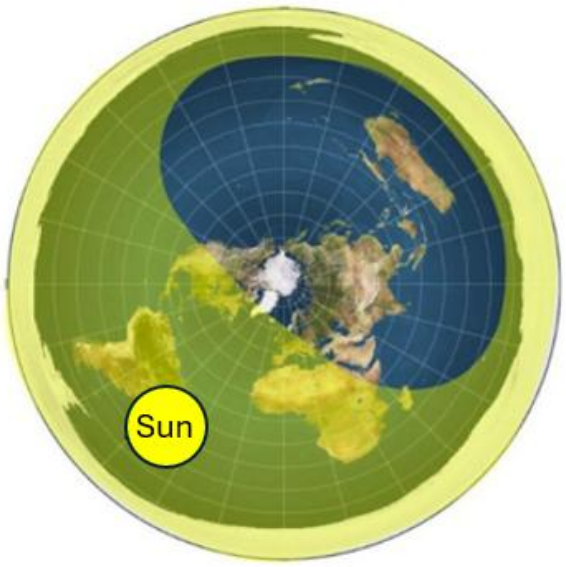
Winter Solstice

The winter solstice, for reminder, is an astronomical event that marks the shortest day and the longest night of the year. In our time, it occurs around December 21st or 22nd in the Northern Hemisphere and around June 20th or 21st in the Southern Hemisphere. During the winter solstice, the Earth's axis is farthest from the Sun, causing the Sun to reach its lowest point in the sky at noon.

(#149) Impossible position of the Sun

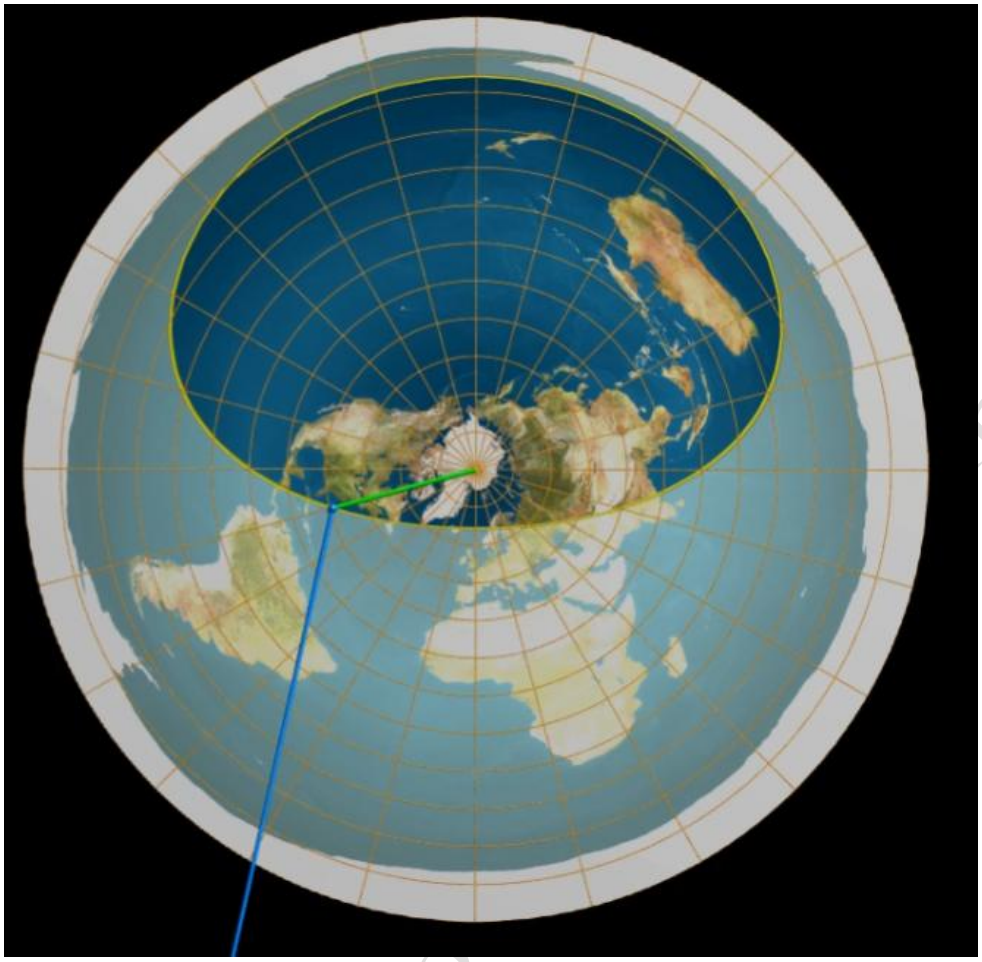
The explanations and illustrations that follow are inspired by and taken from Jos Leys (see his YouTube video here: https://www.youtube.com/watch?v=Yy8sLJZ3XaY).

Here, as a reminder, is the map of the flat Earth at the winter solstice, showing the illuminated and unilluminated parts at noon (we already know that the fact that sunlight bends like that for this is impossible, but anyway…):



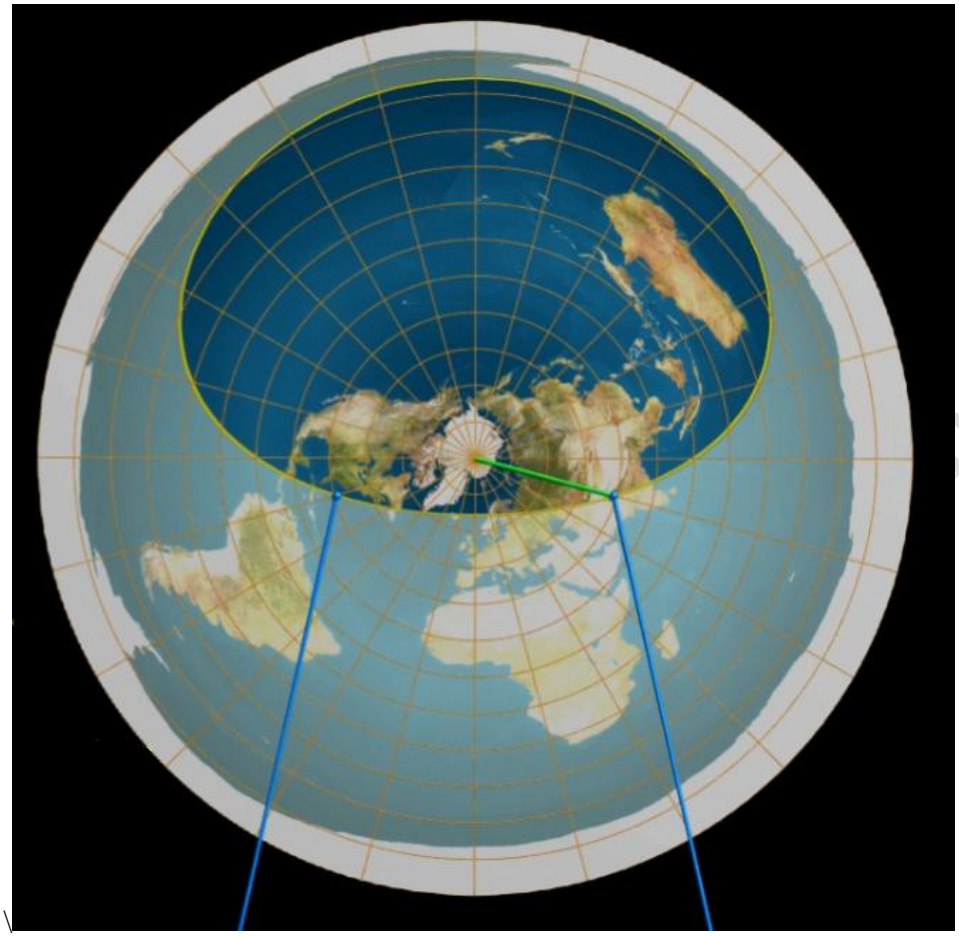
Let's choose a specific latitude. The direction of the Sun at sunrise is the same for all locations at that latitude; this is what we observe in reality. The same is true for sunset!

In reality, on that day, at a latitude of 30°, the "sunrise" (represented by the blue line below) is observed at a direction of 117°. The angle between the blue and green lines visible below represents this reality but superimposed on the flat Earth model:



Always in our reality, on that day, at a latitude of 30°, the "sunset" is at 243°, or -117°, the angle between the blue and green lines below on the right:

translation into



\

These angles can be verified here, for example, for Tallahassee, Florida (USA):

https://www.timeanddate.com/sun/usa/tallahassee?month=12&year=2020

Tallahassee, Florida, USA — Sunrise, Sunset, and Daylength, décembre 2020

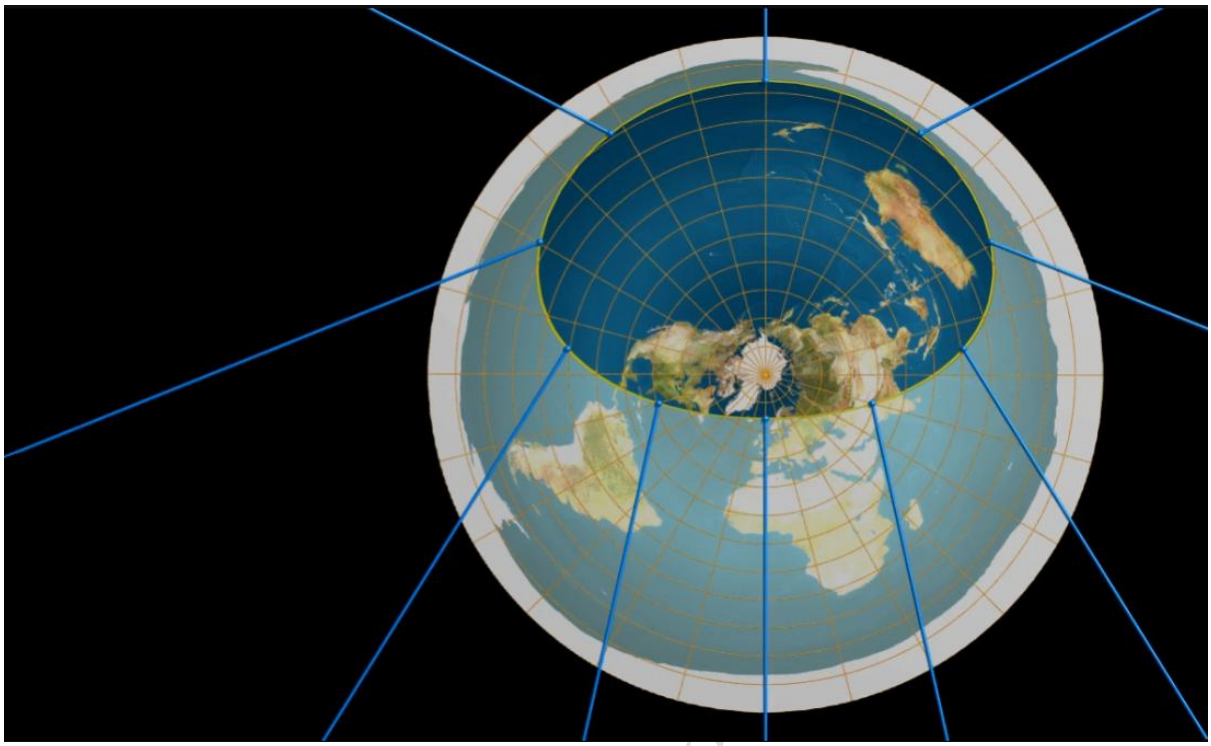
Time/General | Weather | Time Zone | DST Changes | Sun & Moon

Sun & Moon Today | Sunrise & Sunset | Moonrise & Moonset | Moon Phases | Eclipses | Night Sky

Daylight
07 h 10 – 17 h 36
10 hours, 27 minutes

Current Time:	23 nov 2024, 04 h 54 m 20
Sun Direction:	97,97° E →
Sun Altitude:	-28,95°
Sun Distance:	147,716 million km
Next Solstice:	21 déc 2024 04 h 20 (Winter)
Sunrise Today:	07 h 10 ↘ 113° Southeast
Sunset Today:	17 h 36 ↙ 246° West

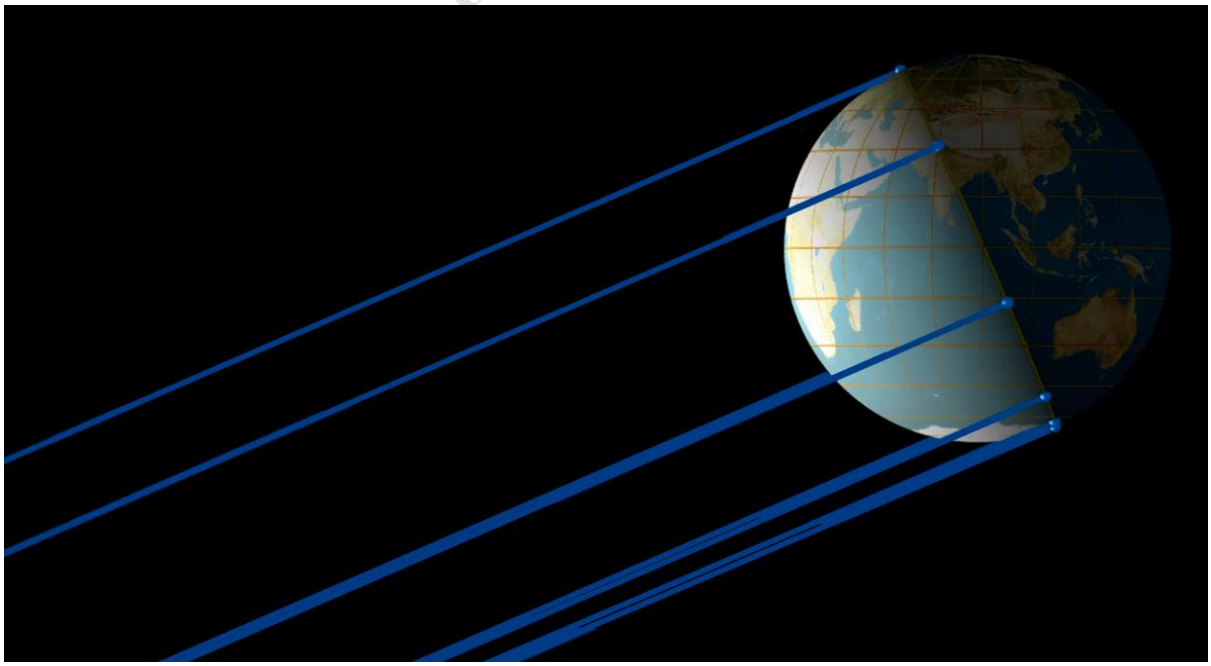
Let's reproduce the reality observed at several points of different latitudes on a flat Earth:



So… where is the Sun actually on this flat Earth since the direction vectors don't converge at a single point?! Is it a quantum Sun that can be in multiple places at the same time?????

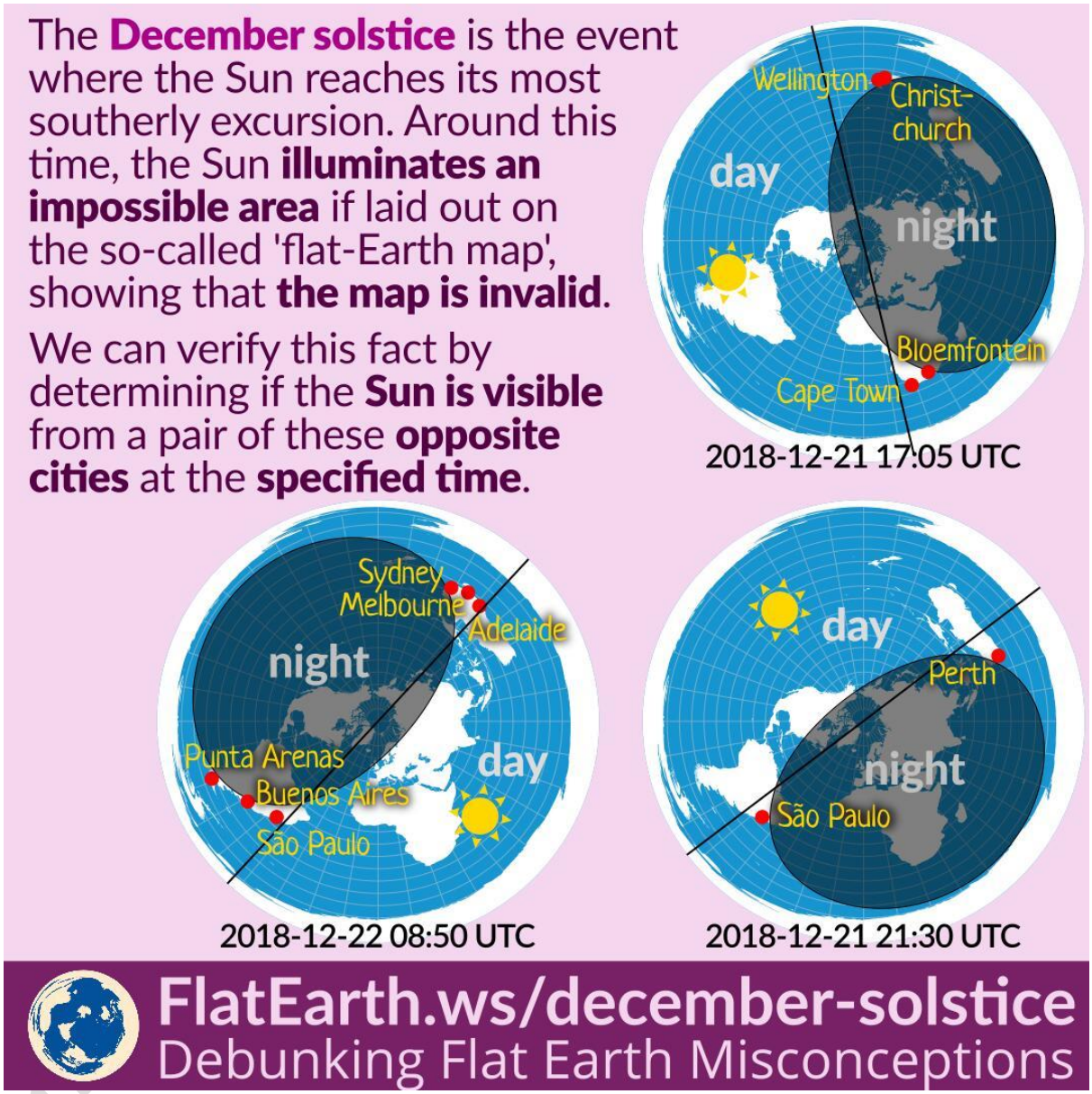
It is certainly not located perfectly above the Tropic of Capricorn…!

Whereas on a globe the explanation is natural:



(#150) Impossible Illumination

The December solstice is the event during which the Sun reaches its southernmost point. At this time, the Sun illuminates an area impossible to represent on the so-called flat Earth map, demonstrating that this map is invalid. We can verify this fact by determining if the Sun is visible from a pair of these cities on opposite sides of the Earth at the specified time.



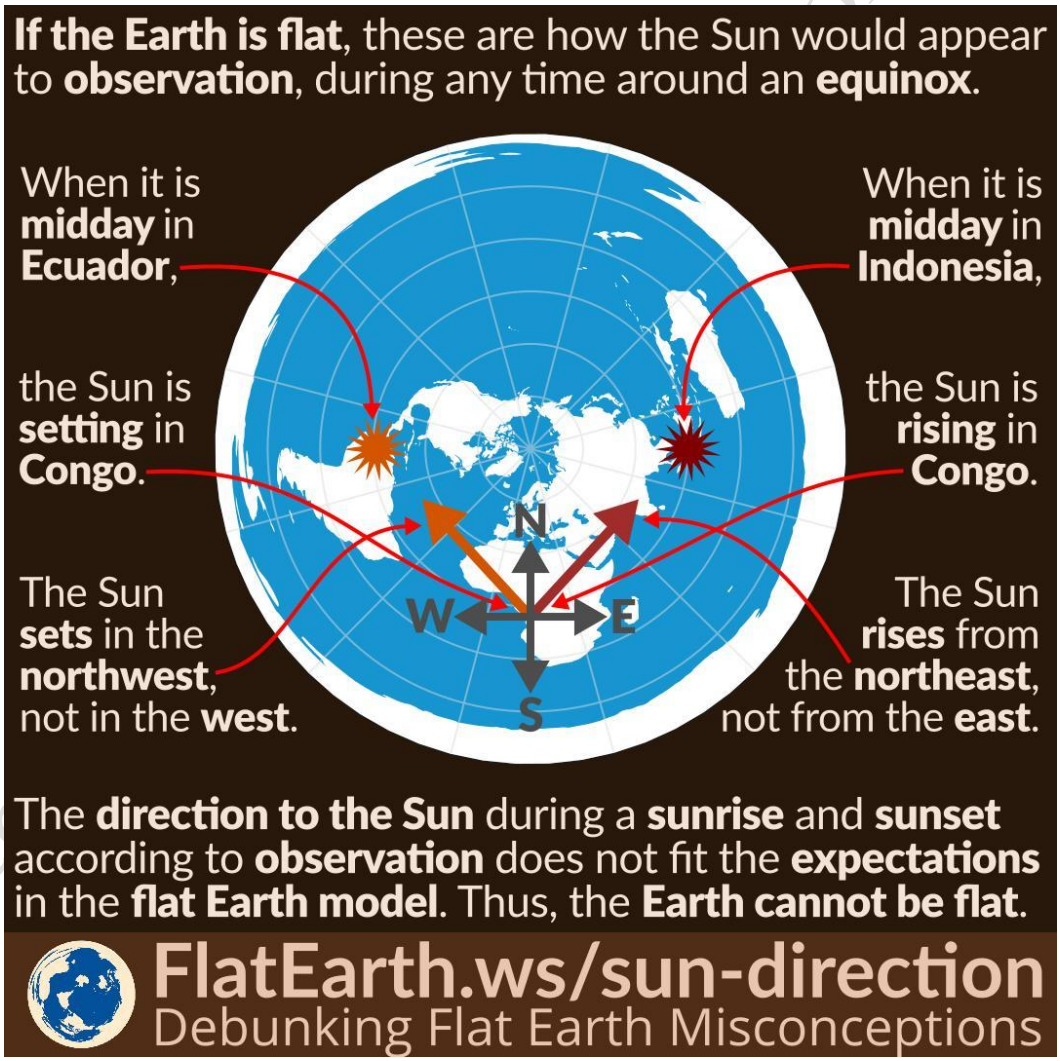
Equinoxes

(#151) Sunrise directions

An equinox is a moment in the year when the Sun crosses the Earth's equatorial plane, thus changing celestial hemispheres. This astronomical definition clarifies the pre-scientific concept that the equinox is the moment when the length of day is equal to that of night plus the lengths of dawn and dusk for planets with atmospheres. Etymologically, the term equinox comes from the Latin *aequinoctium*, from *aequus* (equal) and *nox*, *noctis* (night).

We name spring (or vernal) equinox the equinox of March in the northern hemisphere and the equinox of September in the southern hemisphere. The autumn equinox is the equinox in September in the northern hemisphere and in March in the southern hemisphere.

If the Earth is flat, this is what the Sun would appear to be when observed at any time around an equinox:


If the Earth is flat, these are how the Sun would appear to observation, during any time around an equinox.
When it is midday in Ecuador,
When it is midday in Indonesia,
the Sun is setting in Congo.
the Sun is rising in Congo.
N
W
E
S
The Sun sets in the northwest, not in the west.
The Sun rises from the northeast, not from the east.
The direction to the Sun during a sunrise and sunset according to observation does not fit the expectations in the flat Earth model. Thus, the Earth cannot be flat.
FlatEarth.ws/sun-direction
Debunking Flat Earth Misconceptions

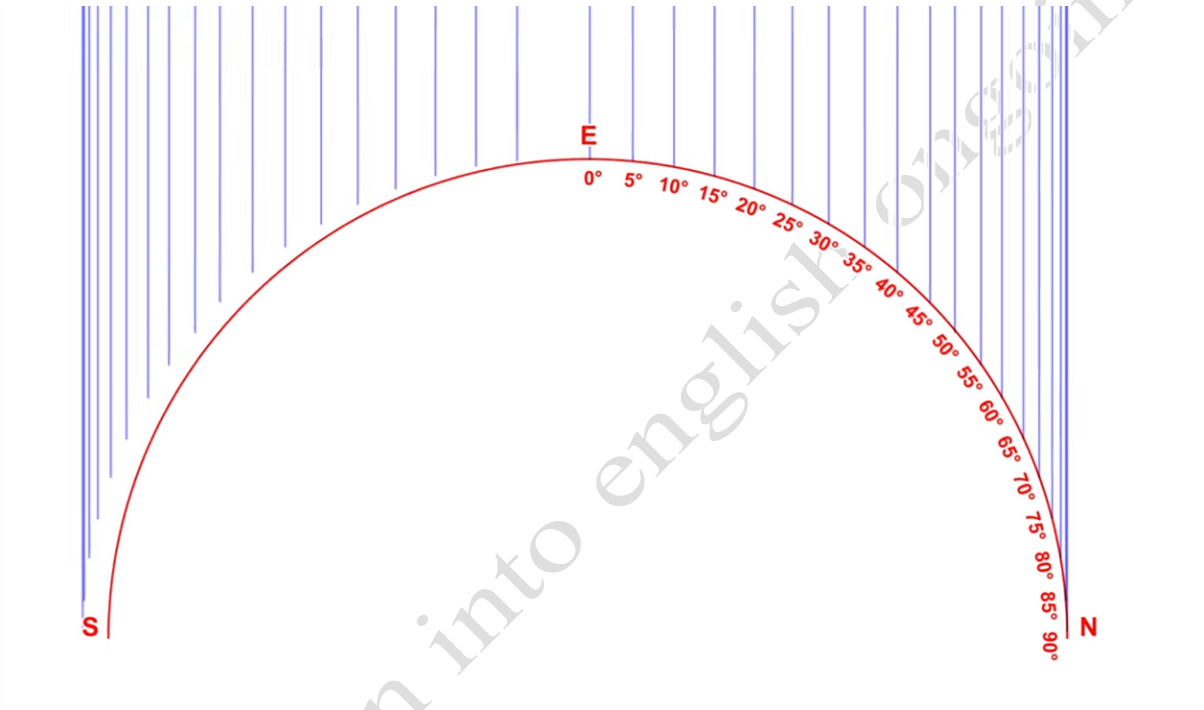
The direction of the Sun at sunrise and sunset, as observed in reality, does not correspond to the flat Earth hypothesis. Therefore, the Earth cannot be flat.

Shadow of a stick

It is possible to prove with several people located at the same longitude but different latitudes during the equinoxes that the Earth is a sphere and that the measurements are incompatible with what is speculated about a flat Earth.

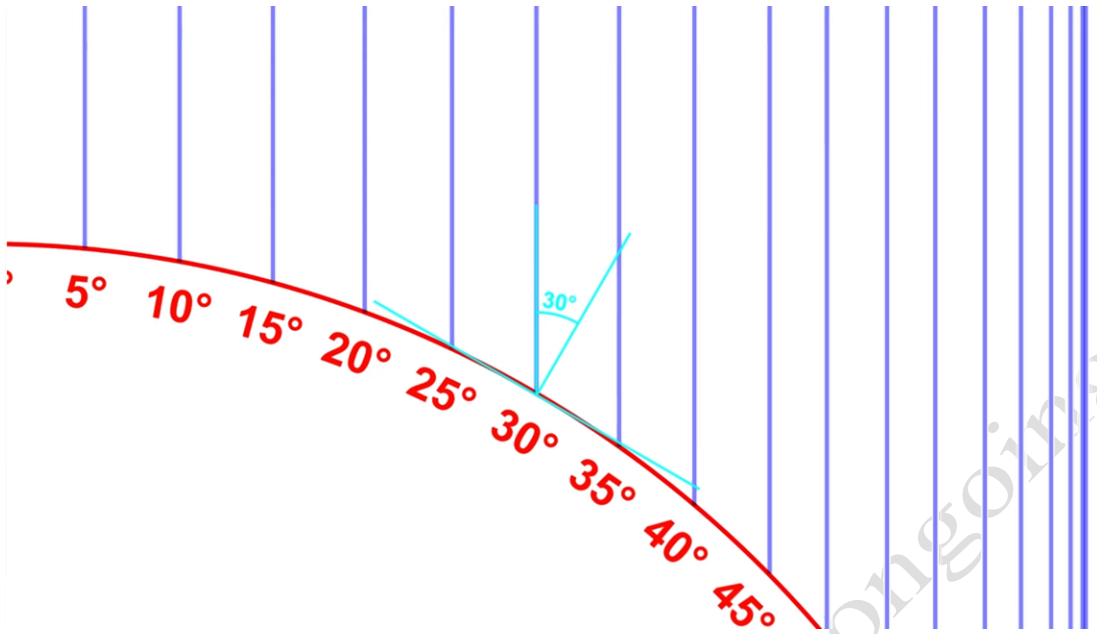
Note: We will not count the shadow of the stick as a proof because it is actually a variation of Eratosthenes' experiment!

On the day of the equinoxes, the Sun is perfectly perpendicular to the equator, and because it is very far away, its rays strike the Earth in an almost parallel fashion, as illustrated below:

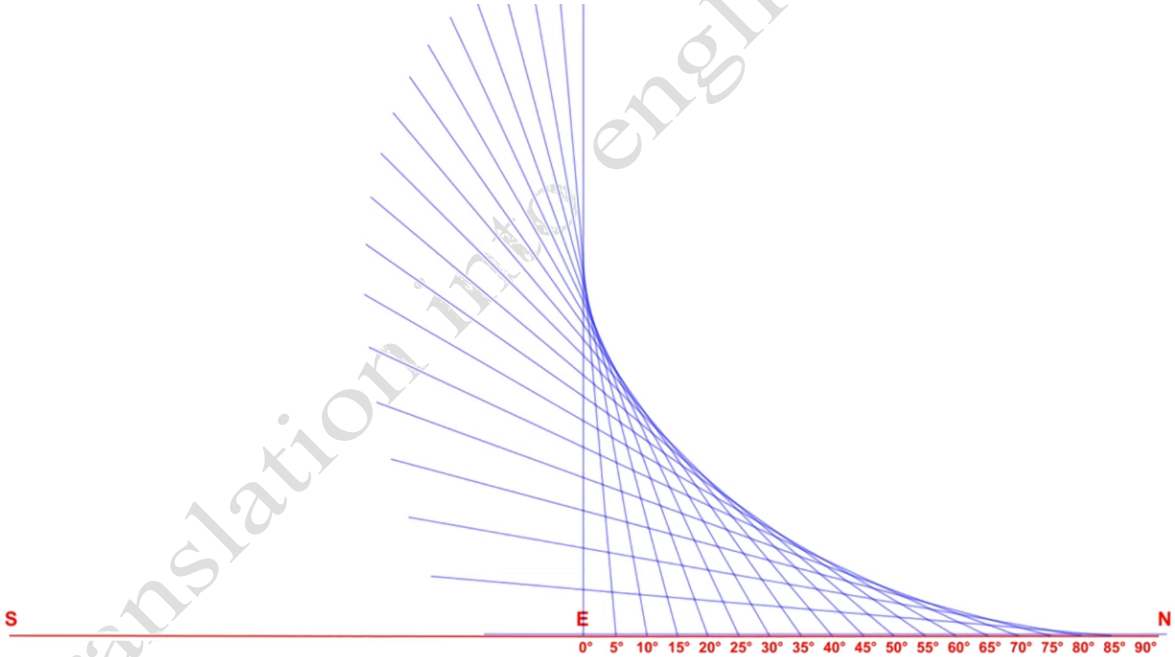


On the day of the equinoxes, we therefore have that the shadow of a stick corresponds to the latitude of the observer, as verified in reality and illustrated below:

translation into english ongoing



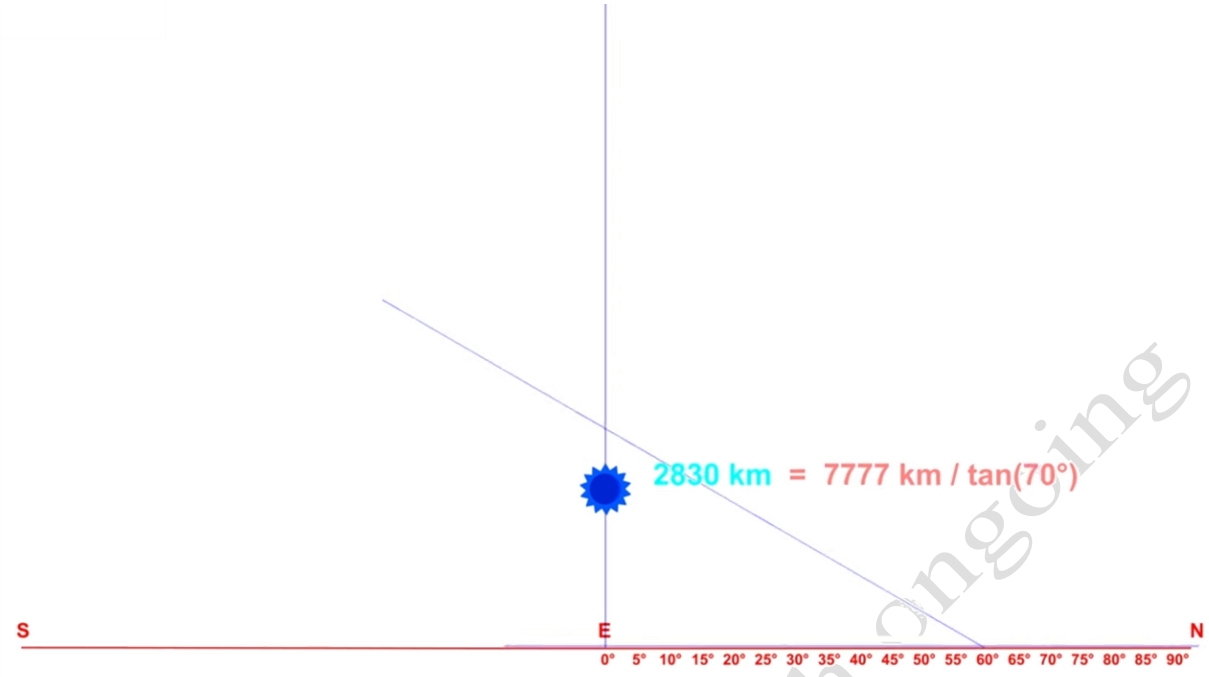
These repeatable, controllable, measurable observations, reproduced on a flat Earth model, should yield:



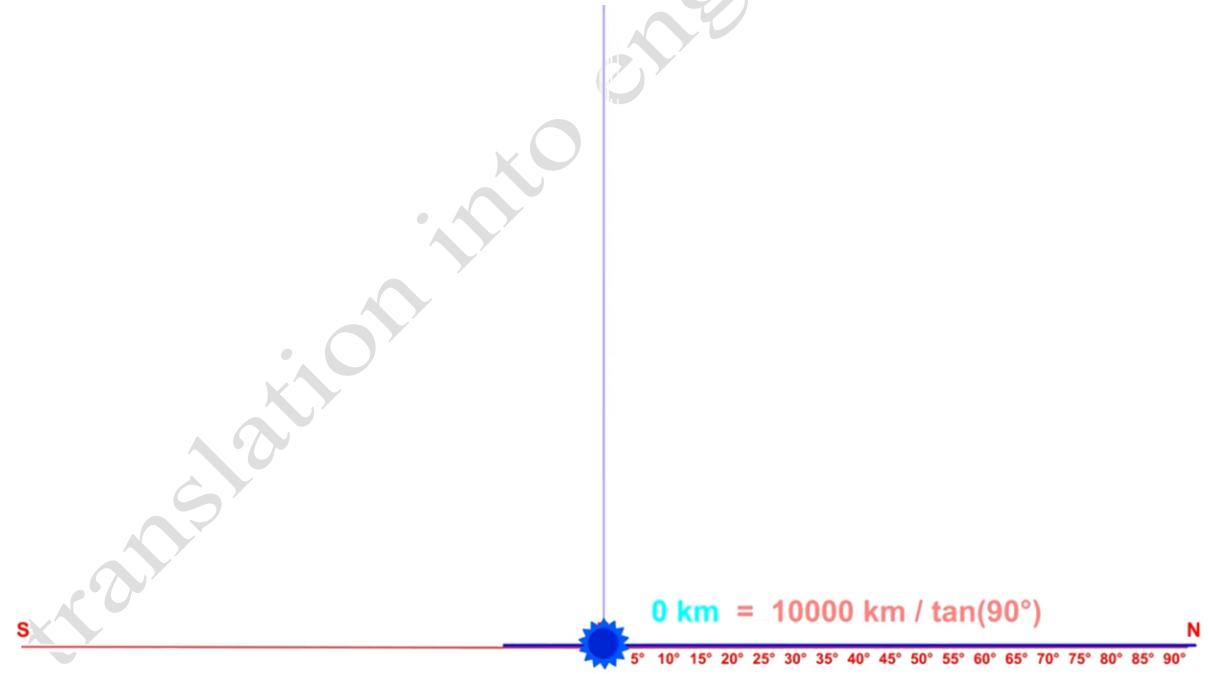
translation in english ongoing

And so here we see a major problem of consistency because this would mean that on a flat Earth either the Sun is in several places at the same time, or the Sun forms a very eccentric ellipse, or the flat Earth hypothesis is wrong…!

Indeed, on a flat Earth we would sometimes have the Sun, which should be at an altitude of 2,830 km as seen from the equator, relative to measurements taken by someone at a latitude of 70°:



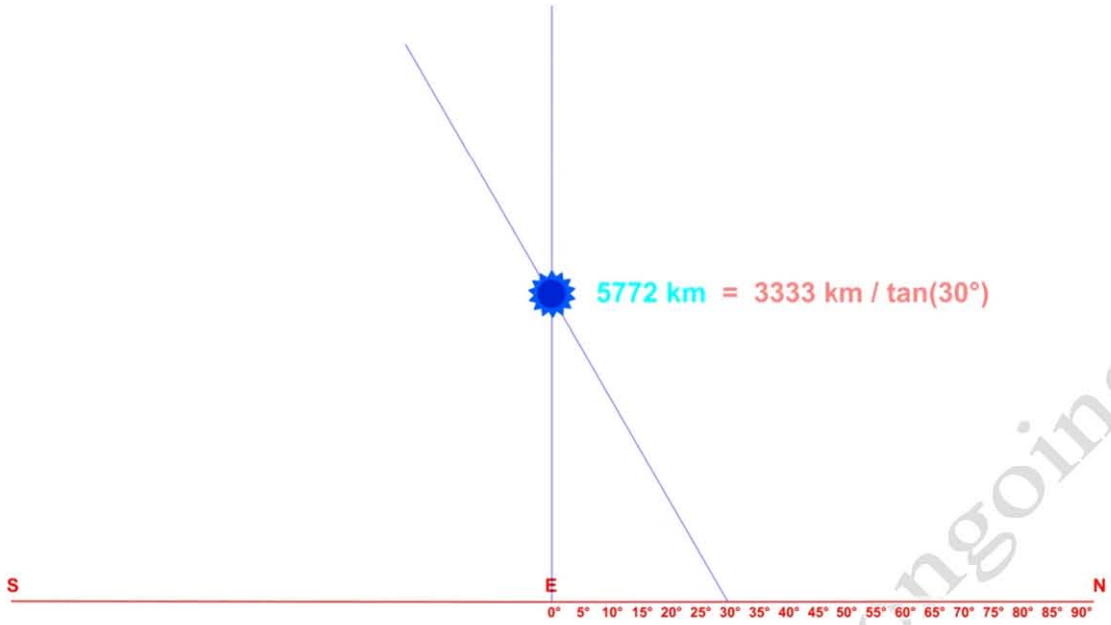
Or the Sun should be at an altitude of 0 km (always at the same time…) as seen from the equator relative to measurements taken by someone at a latitude of 90°:



translation into english ongoing

Obviously all of this is total nonsense, which is why, once again, the flat Earth is just a lie!

Or yet another example of nonsense (we'll stop with the examples here, hoping the reader has understood):



translation into english ongoing

Path of a stick's shadow

We have already addressed the issue of the impossibility of the straight-linear path of the shadow of a stick at the equinoxes on page 184.

translation into english ongoing

(#152) Curvature of light (night/day inconsistency of the flat Earth)

As with flat Earth proponents, the Sun is always above the Earth at an altitude of 5,000 to 6,000 kilometers therefore it can never be night.

But to explain the night, they claim that the sun's rays magically bend or that there is an undetectable and immaterial dome to explain what is illustrated below:

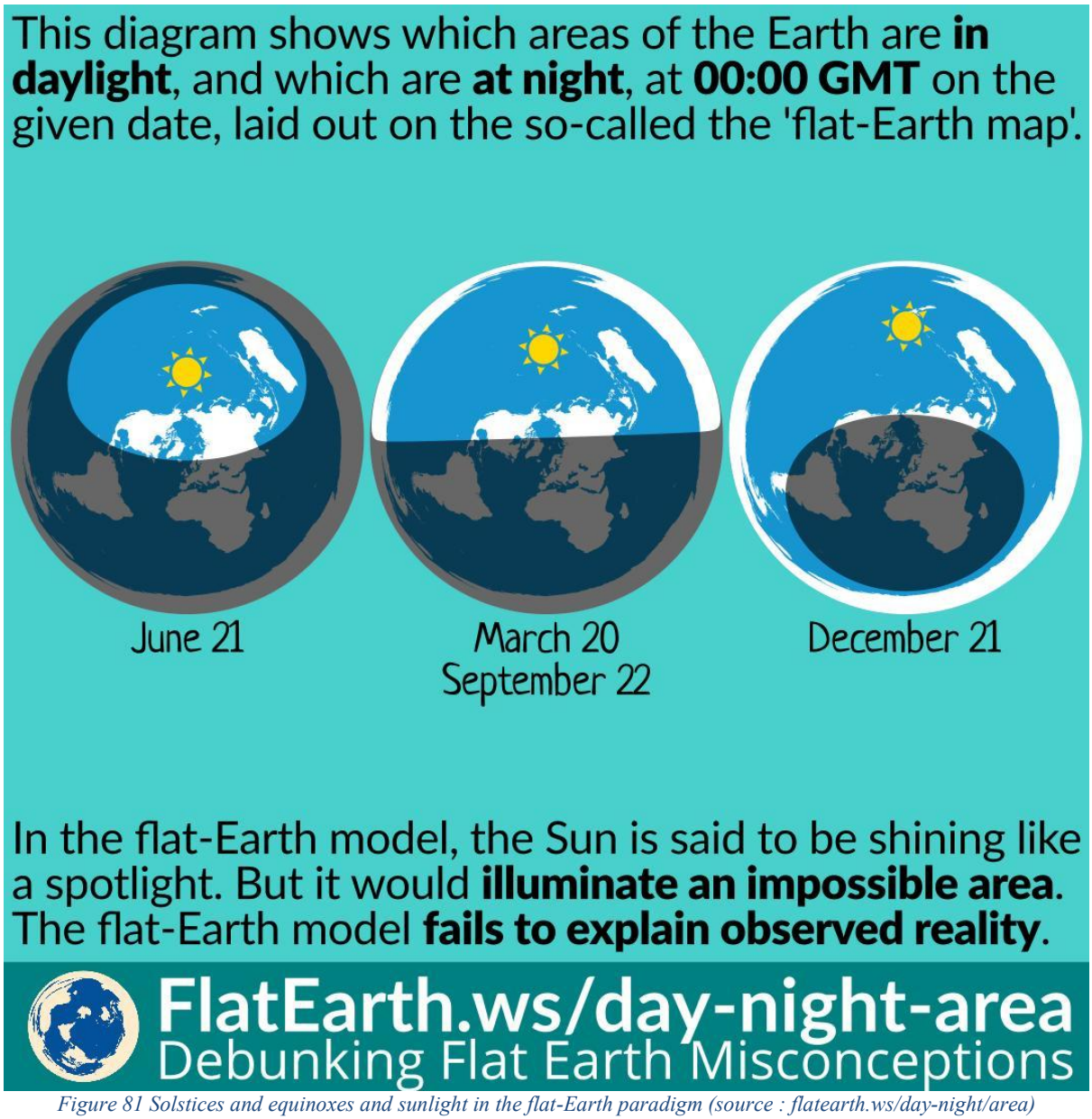
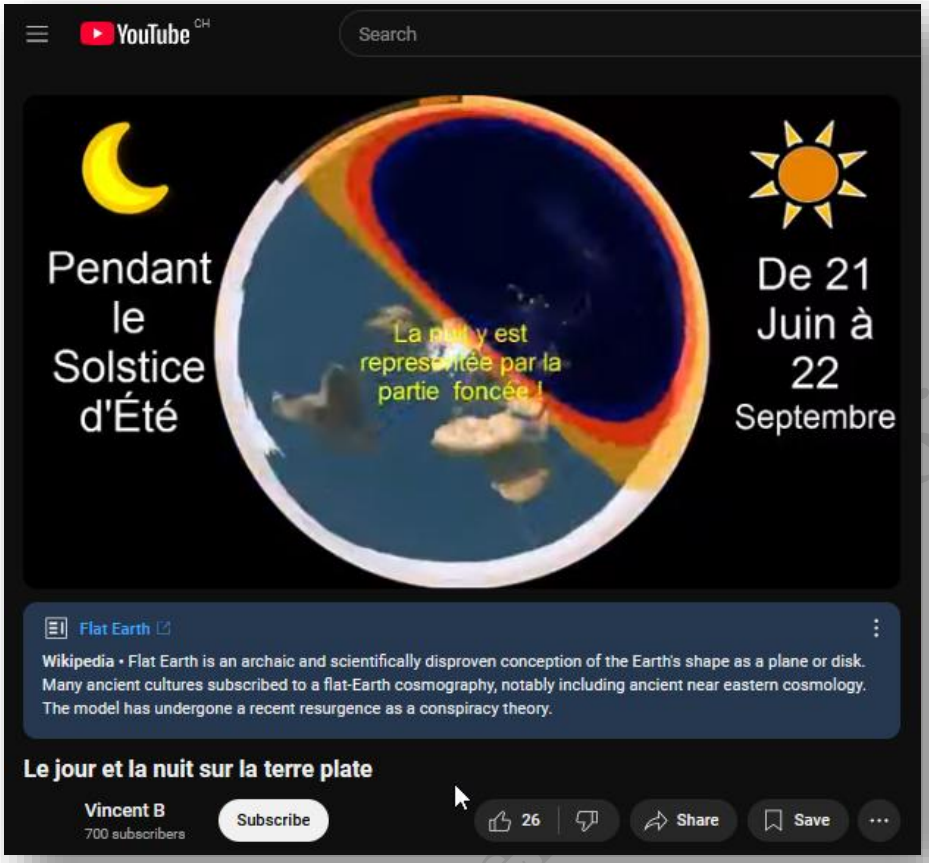

This diagram shows which areas of the Earth are in daylight, and which are at night, at 00:00 GMT on the given date, laid out on the so-called the 'flat-Earth map'.
June 21
March 20
September 22
December 21
In the flat-Earth model, the Sun is said to be shining like a spotlight. But it would illuminate an impossible area. The flat-Earth model fails to explain observed reality.
FlatEarth.ws/day-night-area
Debunking Flat Earth Misconceptions

Figure 81 Solstices and equinoxes and sunlight in the flat-Earth paradigm (source : flatearth.ws/day-night/area)

Whereas on a spherical Earth there is no problem!

An excellent animation that demonstrates the absurdity (since light bends at certain times to 180°…) is available here in french:

https://www.youtube.com/watch?v=BQIfqzv1bMY


YouTube CH
Search
Pendant le Solstice d'Été
La nuit y est représentée par la partie foncée !
De 21 Juin à 22 Septembre
Flat Earth
Wikipedia • Flat Earth is an archaic and scientifically disproven conception of the Earth's shape as a plane or disk. Many ancient cultures subscribed to a flat-Earth cosmography, notably including ancient near eastern cosmology. The model has undergone a recent resurgence as a conspiracy theory.
Le jour et la nuit sur la terre plate
Vincent B
700 subscribers
Subscribe
26
Share
Save

The SEVIRI (Spinning Enhanced Visible and Infrared Imager) rotating sensor on EUMETSAT's Meteosat-9 satellite captured these four views of Earth from a geosynchronous orbit. The images show how sunlight fell on Earth on December 21, 2010 (top left), March 20 (top right), June 21 (bottom left), and September 20, 2011 (bottom right). Each image was taken at 6:12 a.m. local time.

On March 20 and September 20, the terminator is a straight north-south line, and the Sun is supposed to be directly above the equator. On December 21, the Sun is directly above the Tropic of Capricorn as seen from the ground, and sunlight spreads over a larger portion of the Southern Hemisphere. On June 21, the Sun is above the Tropic of Cancer, spreading more sunlight to the north and reversing the situation in the south. The bulge of our spherical Earth blocks sunlight from the far hemisphere at the solstices; this same curvature allows the Sun's rays to spread over a larger area near the top and bottom of the globe.

https://earthobservatory.nasa.gov/images/52248/seeing-equinoxes-and-solstices-from-space

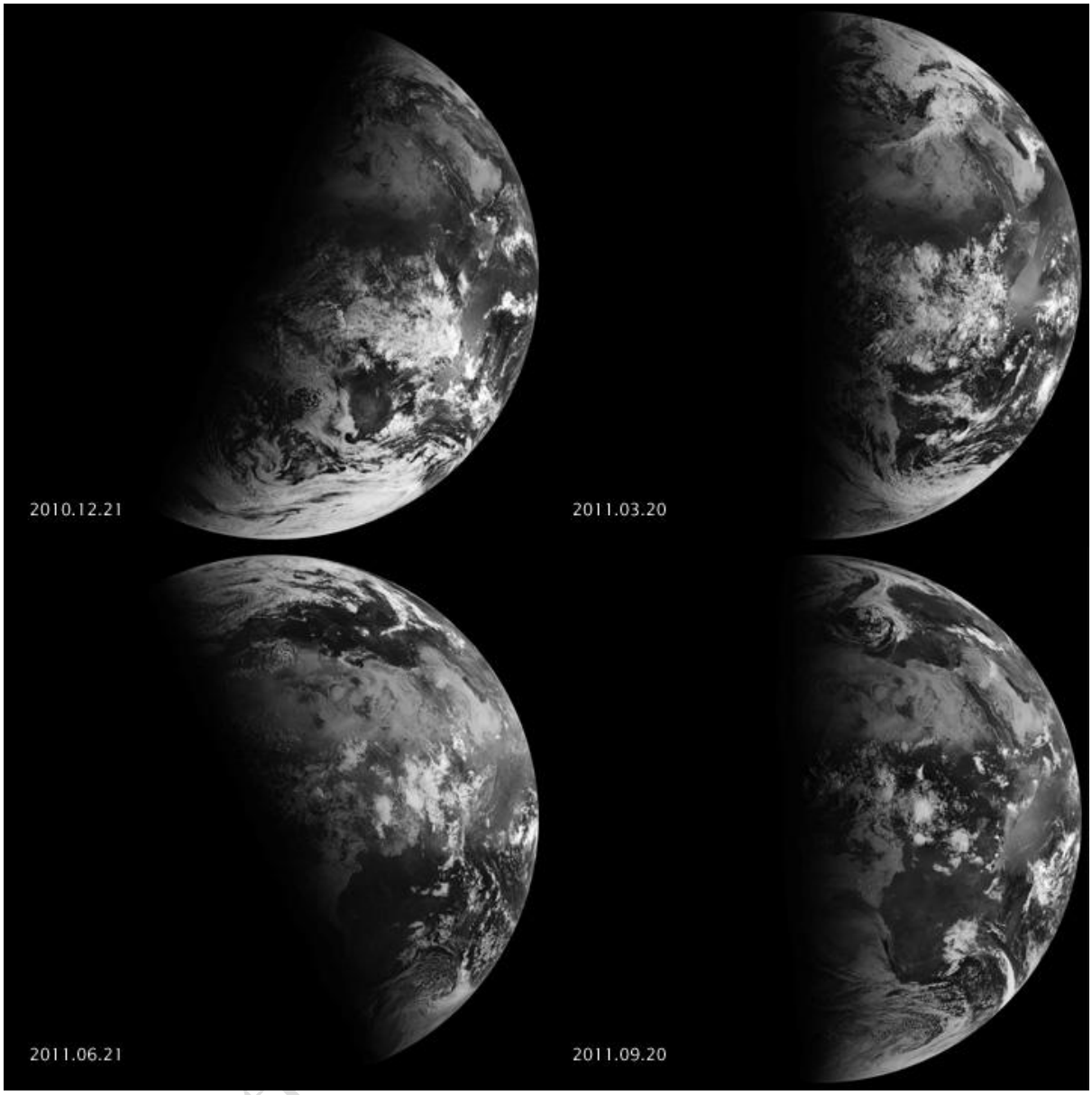


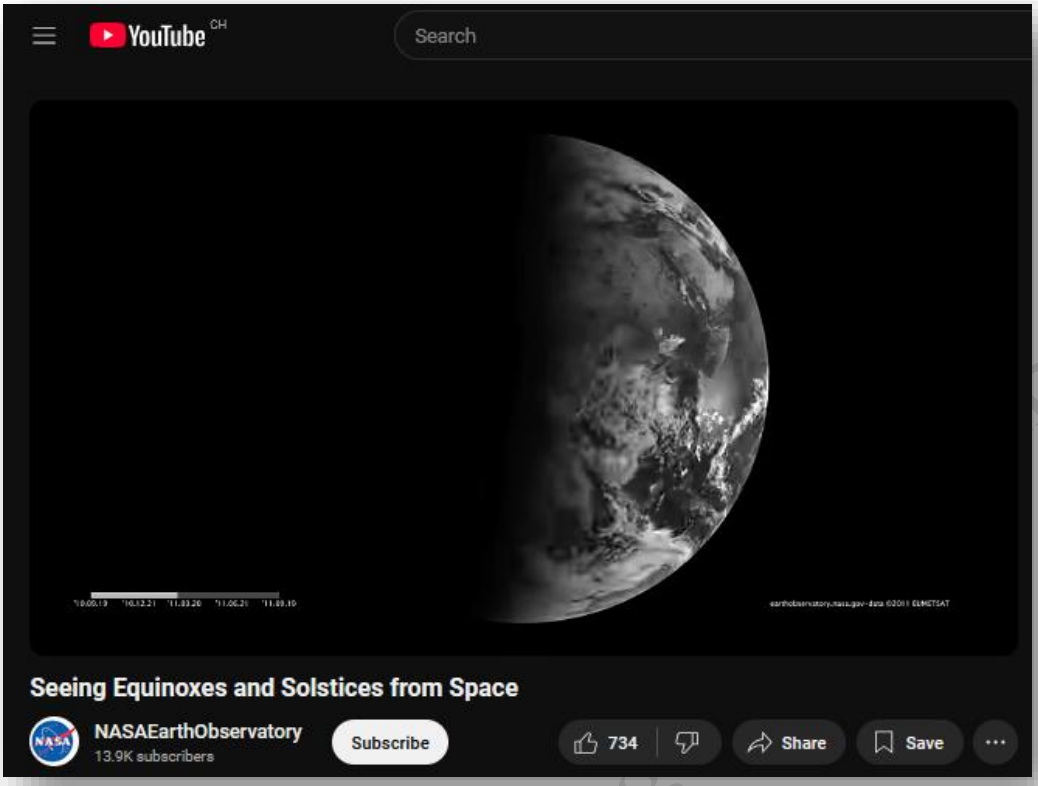
Figure 82 EUMETSAT solstices and equinoxes

The photo above (from the European Meteorological Agency's satellite EUMETSAT) shows:

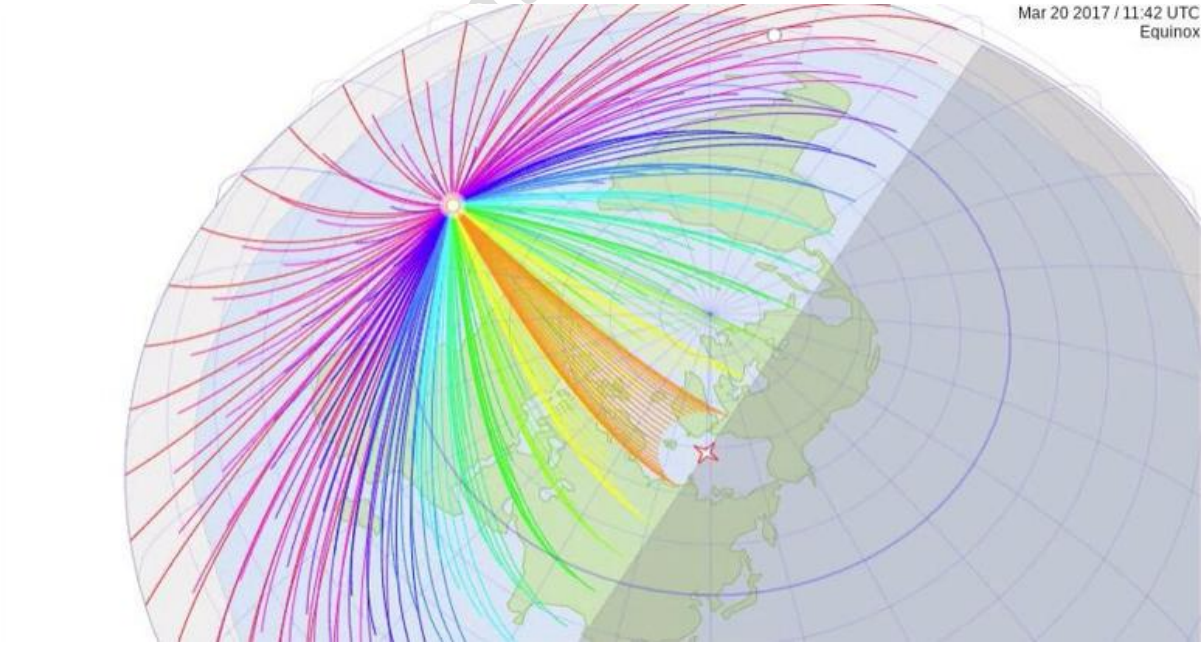
- Winter solstice – 21 december 2010
- Spring Equinox – 20 march 2011
- Summer solstice – 21 june 2011
- Autumn Equinox – 20 september 2011

Whose video is available here:

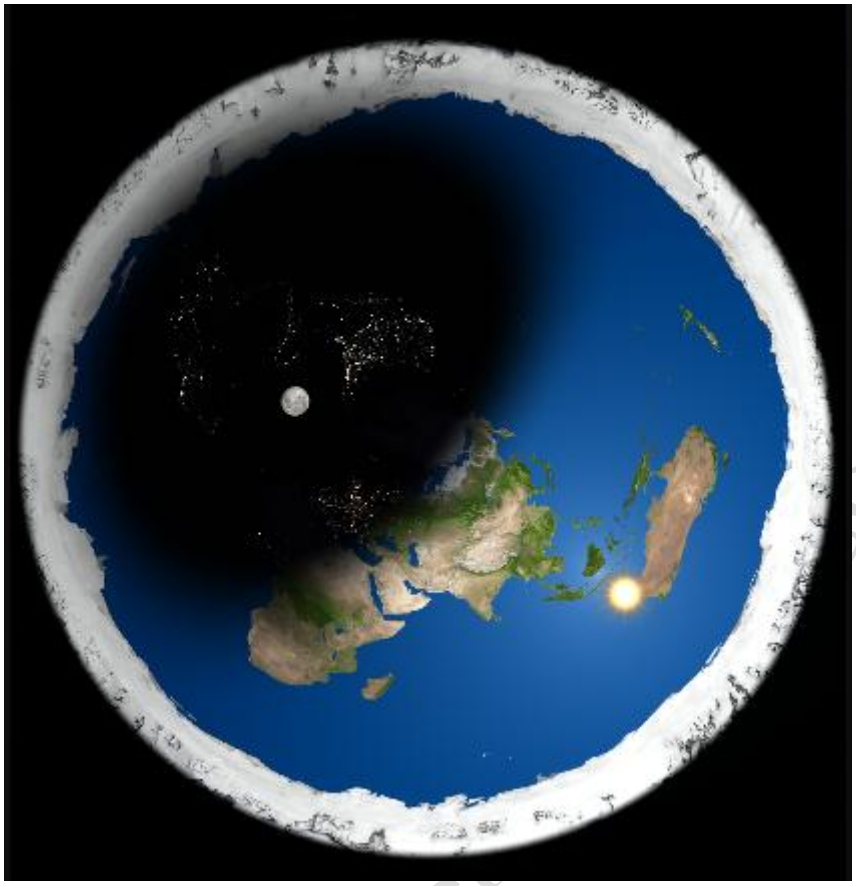
https://www.youtube.com/watch?v=FmCJqykN2J0



Here's how the light should bend on that day according to the fanciful and imaginary hypothesis of flat Earth proponents:



Something more... and funny is that in the Flat Earth hypothesis, it can be nighttime across the entire American continent (North America + South America) at the same time as in Europe during the winter, almost every day:



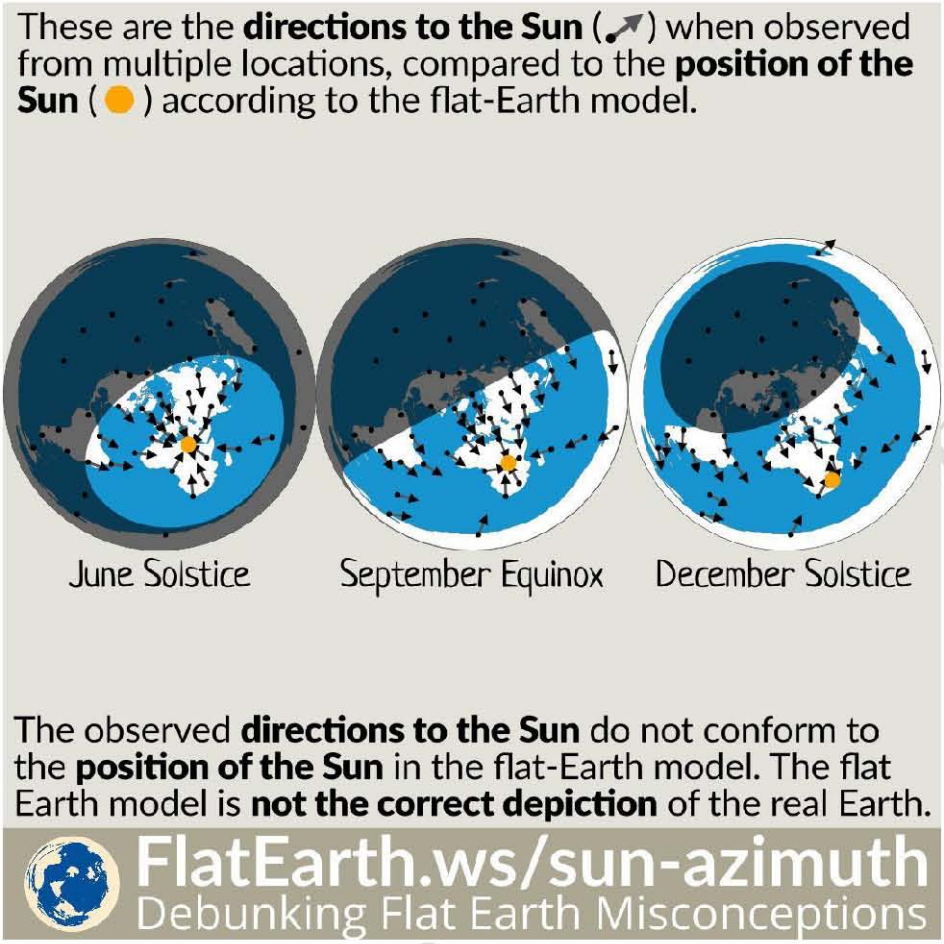
In short, if we compare the light zones of the flat-Earth hypothesis with observations in real life, nothing ever matches!

Here is a link that provides an interactive overview of the globe's dark areas:

https://in-the-sky.org/twilightmap.php

Therefore, both the equinoxes and the solstices prove that the flat Earth theory is inconsistent with the actual position of the Sun:

translation into e... going


These are the directions to the Sun (↗) when observed from multiple locations, compared to the position of the Sun (●) according to the flat-Earth model.
June Solstice
September Equinox
December Solstice
The observed directions to the Sun do not conform to the position of the Sun in the flat-Earth model. The flat Earth model is not the correct depiction of the real Earth.
FlatEarth.ws/sun-azimuth
Debunking Flat Earth Misconceptions

translation into ing

Clouds

We have already mentioned several times that in the paradigm of flat Earth proponents, the Sun is always above the Earth's disk at a distance of approximately 5,000 to 6,000 kilometers.

However, we have photos of shadows of mountains or even clouds projected onto higher altitude clouds, but this is impossible in the paradigm of flat Earth proponents since, according to flattards, all clouds are located below the Sun.

(#153-156) Mountain shadows projected onto the clouds

Let's look at a first photo of Mount Rainier in Washington State (U.S.A.):

Figure 83 2012, Mount Rainier, Washington/U.S.A. (author : PCloadletter26)

And another photo of Mount Hood in the state of Oregon (U.S.A.) this time:

translation

Figure 84 Mont Hood, Oregon/U.S.A. (author : Alex Zimmerman)

Or from Mont Voisin in France:

Figure 85 Mont Voisin/France (11 mars 2016, author : Olivier Joseph)

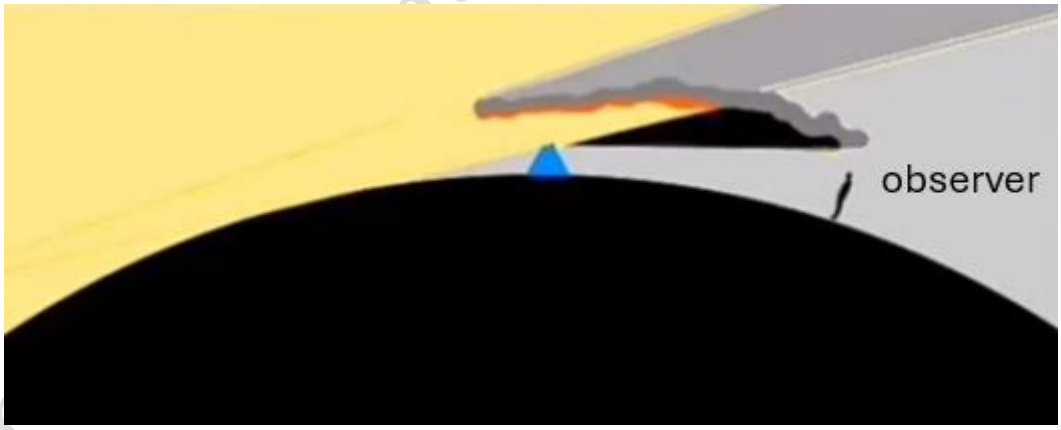
Or from the tip of Neyzets, still in France:

Figure 86 Pointe des Neyzets/France (5th November 2017 at 4:03 PM, author : Olivier Joseph)

Furthermore, for this type of shadow to be possible, the Sun would have to be lower than the height of the mountain…

All these photographs are therefore proof that the Earth is not flat and that the Sun is not local at an altitude of 5,000 kilometers!

These observations are naturally explained on a curved Earth:



(#157-158) Cloud shadows cast onto the clouds

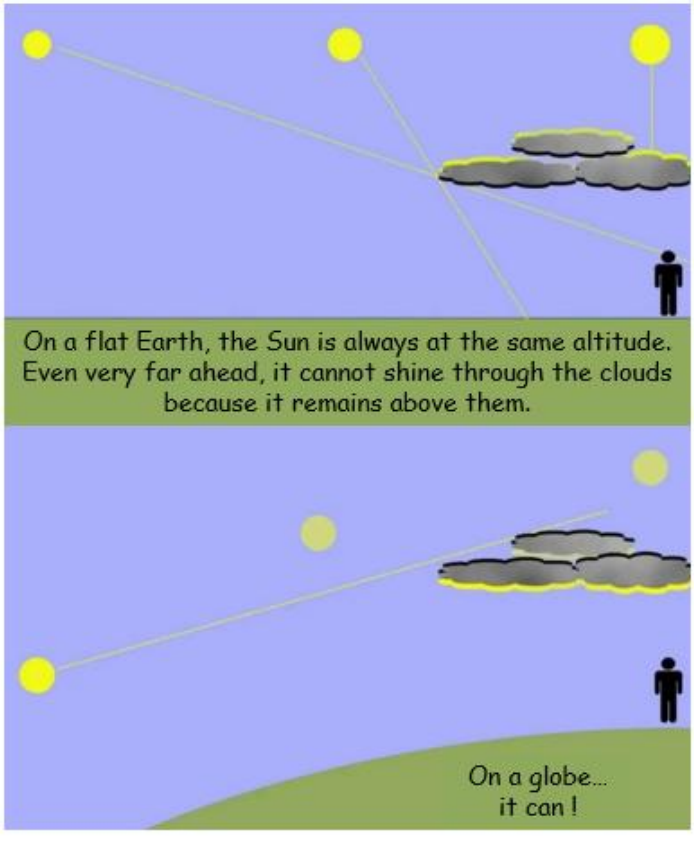
Just as problematic as the shadow of mountains on the cloud cover, we also have the shadow of clouds on the clouds themselves at high altitudes…

For example, we have this photo taken in the Philippines:

Or this photo taken by Craig Roberts:

translation in

All these photos are therefore proof that the Earth is not flat and that the Sun is not local at an altitude of 5,000 kilometers!


On a flat Earth, the Sun is always at the same altitude.
Even very far ahead, it cannot shine through the clouds
because it remains above them.
On a globe...
it can !

(#159) Shadows of condensation trails projected onto the clouds

Just as problematic as the shadow of mountains on cloud cover or the shadow of clouds on stratus clouds, we also have the shadow of condensation trails on the stratus clouds themselves…

Janet Furlong captured the above photo near sunset in Culpeper, Virginia (USA), as a cold front was approaching.

This photo is therefore yet more proof that the Earth is not flat and that the Sun is not local at an altitude of 5,000 kilometers!

translation into en… going

(#160-161) Noctilucent clouds

Noctilucent clouds, also known as “polar mesospheric clouds” (because they form in the mesosphere at an altitude of approximately 80 km) or “luminous night clouds, are tenuous cloud phenomena in Earth's upper atmosphere. Viewed from space, they are named “polar mesospheric clouds” (PMCs), detectable as a diffuse scattering layer of water ice crystals near the polar summer mesopause. They are composed of ice crystals and, from the ground, are visible only during astronomical twilight. The term "noctilucent" means "shining at night" in Latin. They are most often observed during the summer months between latitudes 50° and 70° north and south of the equator. Too faint to be seen in broad daylight, they are only visible when the observer and the lower layers of the atmosphere are in the Earth's shadow, but while these very high clouds are still in sunlight (Height, structure and displacements of noctilucent clouds, 1962).

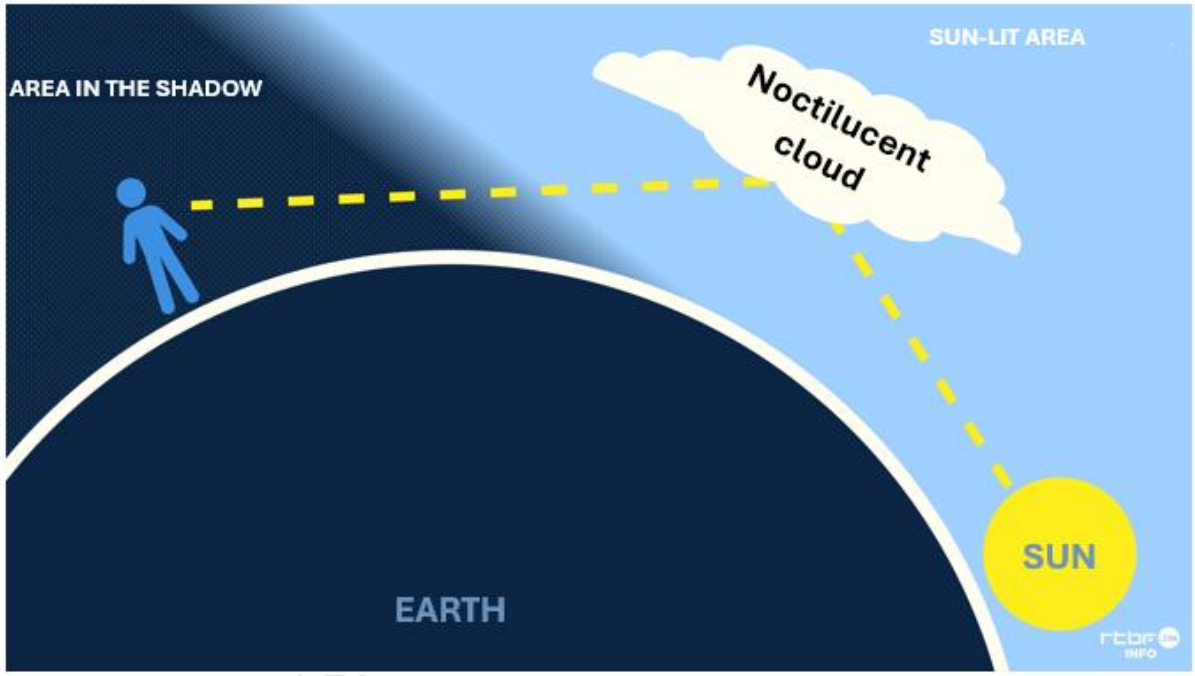


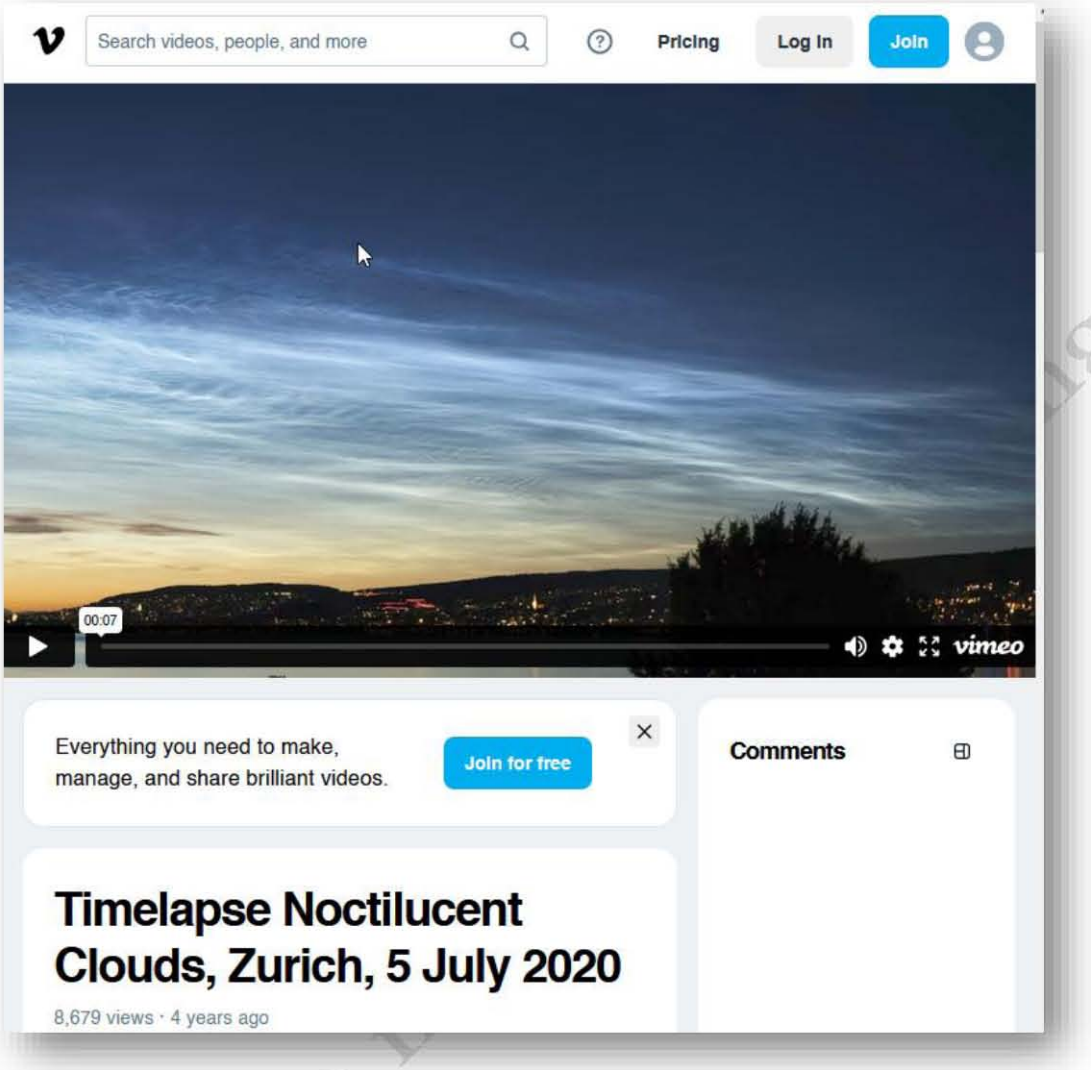
Figure 87 Visibility conditions of noctilucent clouds from the Earth's surface

There are thousands of photos of noctilucent clouds. For example, the photo below shows noctilucent clouds taken from the Kuresoo peat bog in Soomaa National Park, Estonia:

Or in Paris (France) on July 14, 2009:

Here is a timelapse of noctilucent clouds over Zurich (Switzerland) on July 5, 2020:

https://vimeo.com/435648016



translation

(#162) Clouds cut by the horizon

The photo below clearly highlights cumulus clouds cut off by the curvature of the Earth. This is particularly noticeable with those located on the far right of the image, on the Earth's horizon line:

Figure 88 Photo taken with a Nikon Z6 with a Zeiss 100/2 lens from Fort Alban (Nice) on September 29, 2024 at 06:33:20 local time (credit: Christophe S.)

This is yet a supplementary proof that the Earth is not flat!

There is also another photo of the same kind, with the same conclusion, but we have not been able to contact the author and therefore we do not have the technical information (position, date, place, device):

Or also this photo taken by Agnès Etchegoyen with her Nikon Z9 at 600mm on the November 31, 2025 at 17:55 local time at GPS coordinates 18°5°27.252°N and 63°4°47.4°W with the *Dumont d'Urville* boat in the foreground:

(#163) Rising shadow at sunset

At sunset, mountain peaks lose sunlight later than the areas surrounding them. For an observer looking at a mountain, a shadow will appear rising from the base to the summit.

This phenomenon occurs because the Earth is a sphere and the Sun disappears below the horizon.

Anyone can test with a flashlight or LED that on the flat Earth model with a local Sun at a constant altitude, this observation is impossible!

translation into en

(#164) Catoptric effect

Even phenomena as common as the daily sunrise and sunset can, upon close examination, reveal surprising and unexpected things that only recently attracted the attention of scientists and took a long time to be explained. From the systematic observation of sunrises over the sea horizon, the Italian astronomer Annibale Riccò[6] (1844–1919) unexpectedly claimed to have discovered new and unprecedented evidence of the Earth's curvature by scrutinizing distorted images of the Sun reflected by the water. Others had already reached a similar conclusion, but it was Riccò's pioneering work that brought this "catoptric" proof of the Earth's curvature to the forefront of scientific thought in his time (Annibale Riccò and the catoptric proof of the Earth's curvature, 2022).

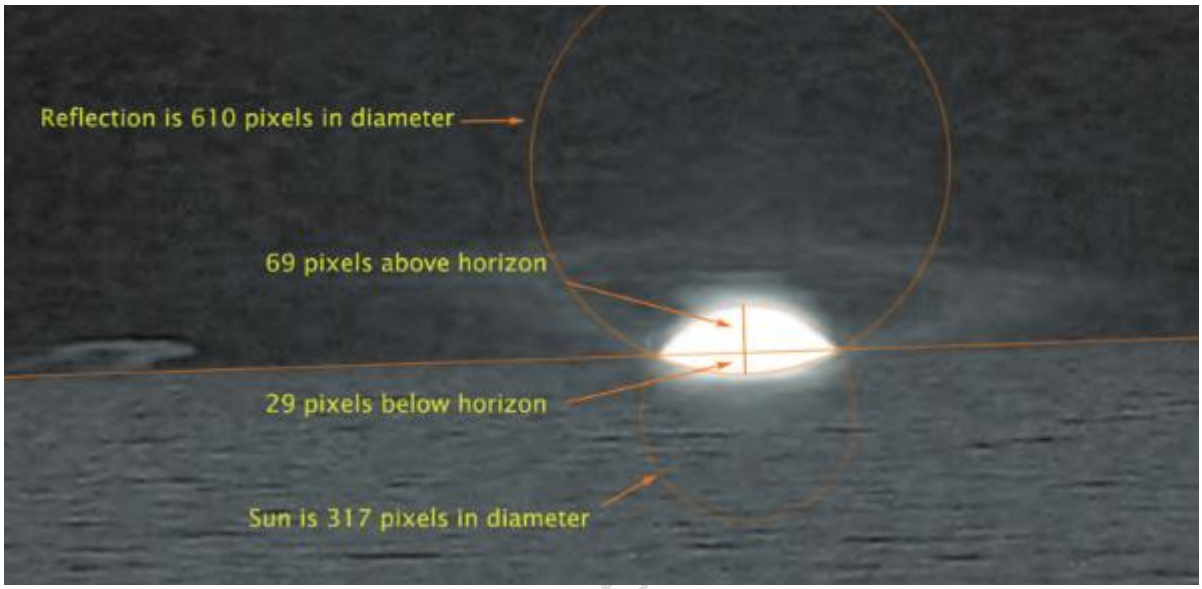
translati ongoing

[6] An Italian astronomer and astrophysicist, he is best known for his extensive research on sunspots and solar prominences.

(#165) Reflections on water

If the Earth were flat, the water calm, and the air clear, the Sun would create a perfect mirror reflection on the water. The sunset image shown below was taken above the lake.

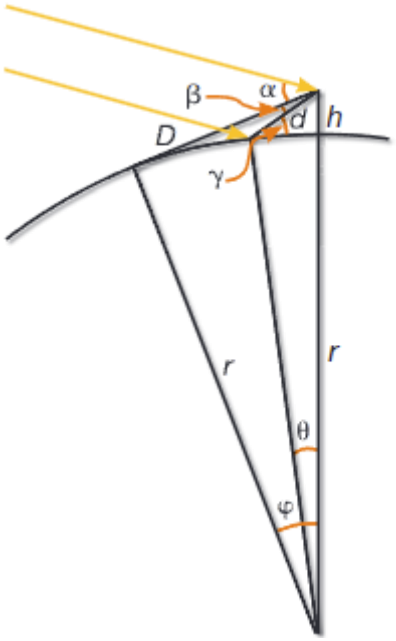
Michigan (USA), July 5, 2008. The cropped close-up above shows a reflection that is clearly foreshortened. While there may be many optical effects at play, such foreshortening can only be explained by the curvature of the Earth.



Here, we show how to measure the Earth's diameter from an image like this one. We also address various complex problems, the most important being the effect of waves that make the surface rough.

In his paper (The Earth Is Not Flat: An Analysis of a Sunset Photo, 2008), Vanderbei (PhD in mathematics from Princeton University) proves, based on:

translation into



That we have the radius of the Earth given by:

$$r = \frac{2h}{\varphi^2} = \frac{2h}{\left[\sqrt{\beta^2 + \left(\frac{\alpha - \beta}{2}\right)^2} - \beta + \frac{\alpha - \beta}{2}\right]^2}$$

As shown in the figure above, we take:

$$\alpha = \frac{69}{317} \cdot 0.5° = 0.00197 \text{ [rad]}$$

$$\beta = \frac{29}{317} \cdot 0.5° = 0.00814 \text{ [rad]}$$

$$h = 2.13 \text{ [m]}$$

We then find:

$$r = \frac{2 \cdot 2.13}{\left[\sqrt{0.000814^2 + \left(\frac{0.001907 - 0.0008414}{2}\right)^2} - 0.000814 + \frac{0.001907 - 0.000814}{2}\right]^2}$$

Hence :

$$r \cong 8\,292 \text{ [km]}$$

Compared to an average of 6,371 kilometers according to recent measurements…

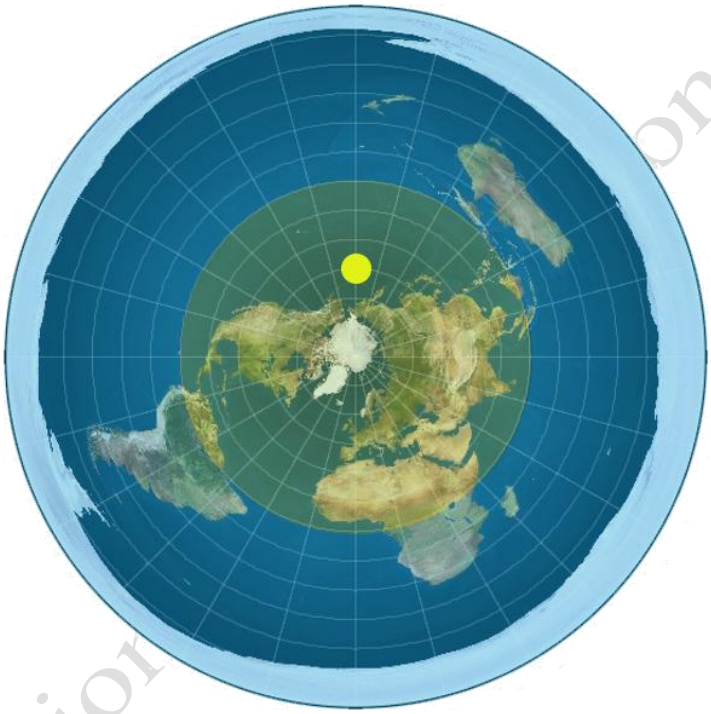
translation into english ongoing

(#166) Angular momentum violation

Among the conservation laws, there is the law of conservation of angular momentum! However, the flat Earth model requires violating this last one (but let us remember that the model of the proponents of the flat Earth also violates Kepler's laws, Newton's laws, the laws of thermodynamics, General Relativity, Maxwell's 4 laws, etc.).

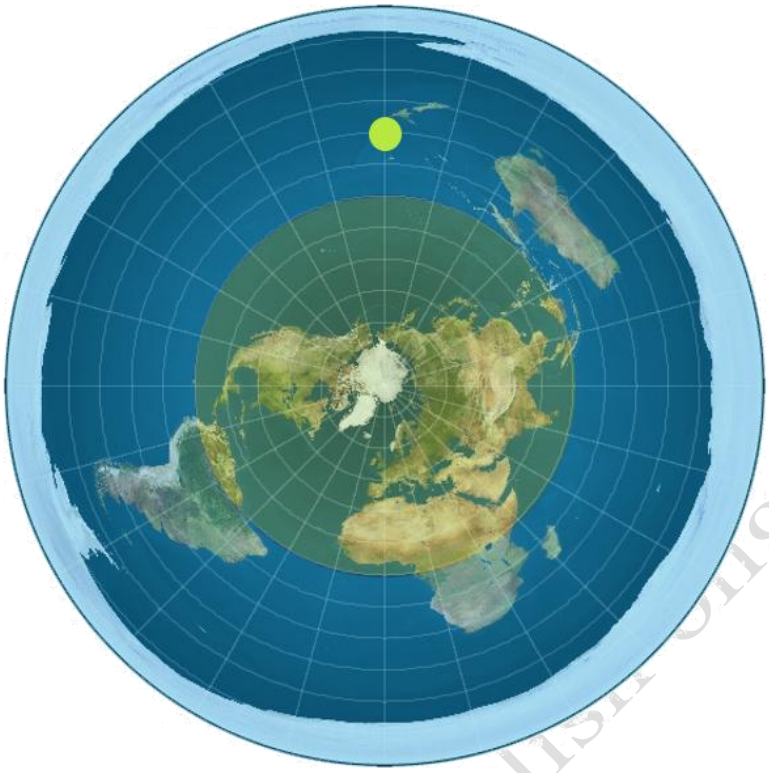
Indeed, in their model, between the seasons the Sun, via an inexplicable and unexplained dynamic of the flat Earth proponents, moves away from or towards the center of the disk as illustrated below.

We have the following for the summer in the Northern Hemisphere:



And for winter in the Northern Hemisphere:

translation ongoing



$$\frac{dL}{dt} = 0 \Leftrightarrow L = mr^2\omega = c^{te}$$

Therefore, we must have:

$$L_{hiver} = L_{été}$$

That's to say :

$$m_s r_h^2 \omega_h = m_s r_e^2 \omega_e$$

But, $\omega_h = \omega_e$ because $1\text{d} = 24\text{h}$. Therefore :

$$r_h^2 = r_e^2 \Leftrightarrow r_h = r_e$$

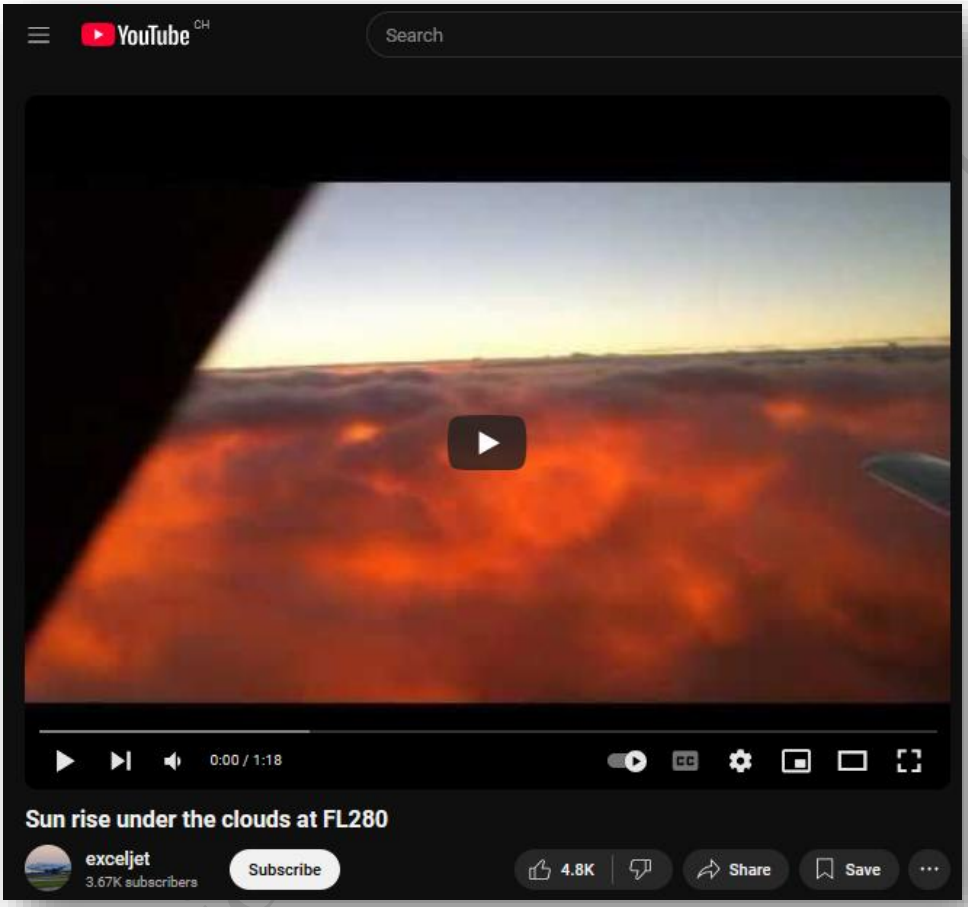
Therefore, there is a contradiction! The flat Earth hypothesis is not possible.

translation into english ongoing

(#167) Refraction of the atmosphere

An excellent evidence that the Earth is curved (and therefore not flat) is the relatively rare observation visible in the video available via the following link:

https://www.youtube.com/watch?v=XQKS0kvTWzQ



The aircraft is at standard altitude known as "FL280" (approximately 8,534 meters):

translating

We get from there the following screenshots:

And that's not possible on a flat Earth! Why? Simply because:

1. The plane is only at a high of 8,500 meters
2. Since the clouds are below, let's say they are at approximately 8,400 meters.
3. So, according to flat-Earthers, the Sun is below the clouds…

4. But flat-Earthers say that the Sun is about 48,000 meters (48 kilometers) away, whereas in the video it is less than 8,400 meters away

5. Another problem… according to flat-Earthers, their local Sun has a radius of 26 kilometers (Sun is a light 32 Miles Across, 1978).. But if it has that size and its position is below 8.5 km (cloud height)… that means 18 kilometers of the Sun are in the ground or in the ocean…

6. In short, we're living in a Walt Disney movie with the flat-Earthers…

translation into english ongoing

Planetary Transits

In astronomy, a transit is the passage of a celestial object between the observer and another object.

The flat Earth hypothesis imposes, as we have mentioned and seen several times, that the Sun and the Moon are always above the flat Earth (and they are "local").

However, in addition to the numerous problems with the flat Earth that we have observed so far, there are the transits of two celestial bodies that we know to be planets of roughly equal or greater size than the Moon…

So the fact that transits exist and are an easily observable fact is proof that the Earth is not flat, otherwise we could always see these local bodies above the flat Earth at an altitude lower than that of the Sun while having dimensions roughly equal to or greater than that of the Moon.

Not to mention the precession of Mercury's perihelion, which flat-Earthers are unable to predict since they have no model, while General Relativity explains it perfectly.

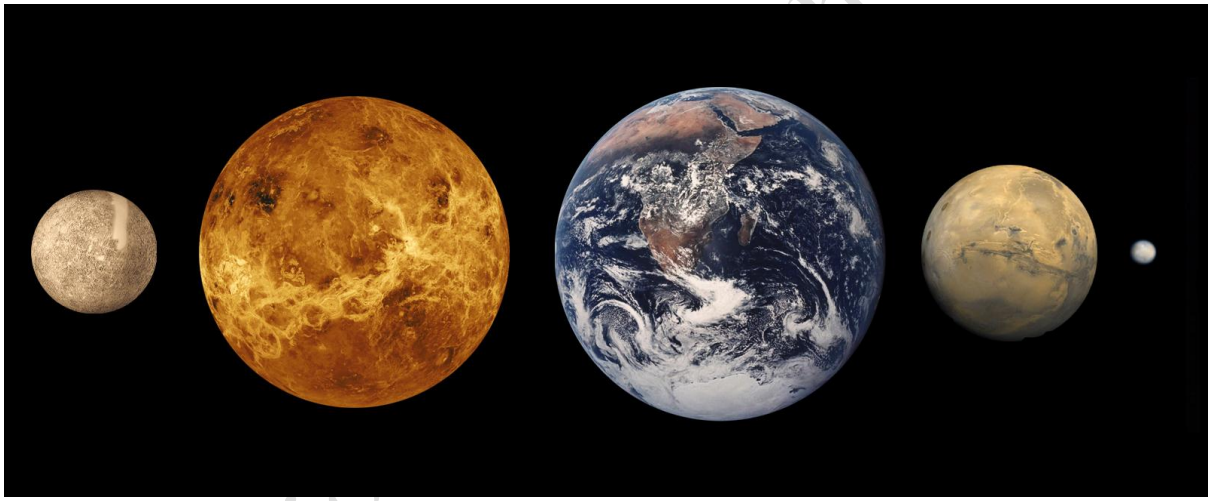


Figure 89 The inner planets. From left to right: Mercury, Venus, Earth, Mars, and the terrestrial dwarf planet Ceres (sizes to scale, source: Wikipedia)

translation ongoing

(#168) Transit of Venus

A transit of Venus across the Sun occurs when the planet Venus passes directly between the Earth and the Sun, obscuring a small portion of the solar disk. During the transit, Venus can be observed from Earth as a small black disk moving across the Sun. The duration of such transits is generally a few hours (the 2004 transit lasted 6 hours). A transit is similar to a lunar solar eclipse, but although Venus is almost four times the size of the Moon, it appears much smaller due to its greater distance from Earth and its closer proximity to the Sun.

So the fact that this transit exists and is an easily observable fact is proof that the Earth is not flat, otherwise we could always see these local bodies above the flat Earth at an altitude lower than that of the Sun while having dimensions roughly equal to or greater than that of the Moon.

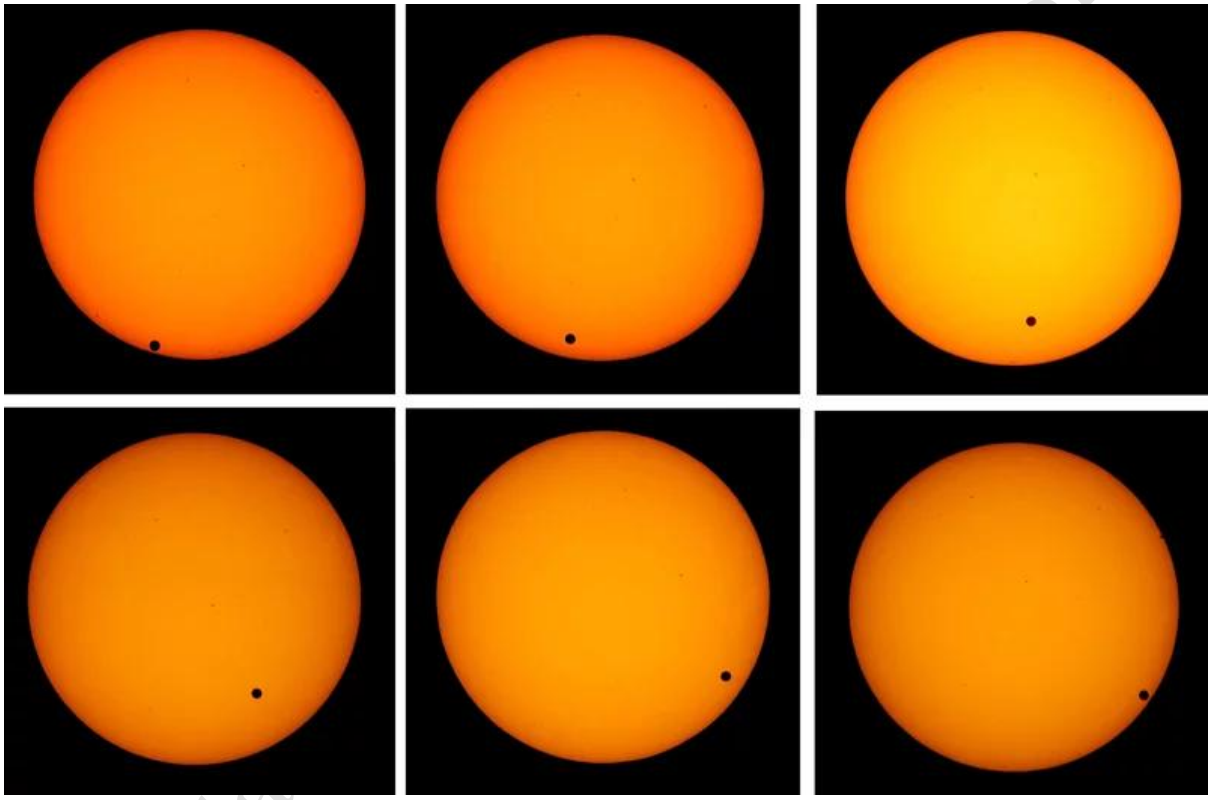


Figure 90 The planet Venus appears as a small black dot as it passes in front of the face of the Sun on June 8, 2004 (author: Ian Waldie)

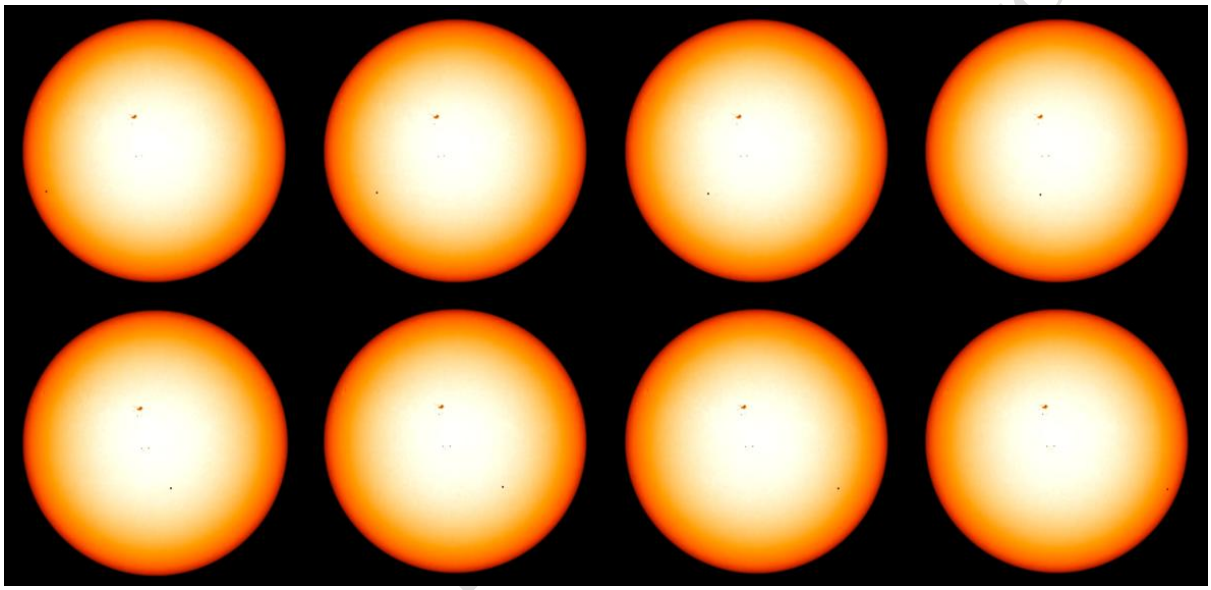
transl

(#169) Mercury Transit

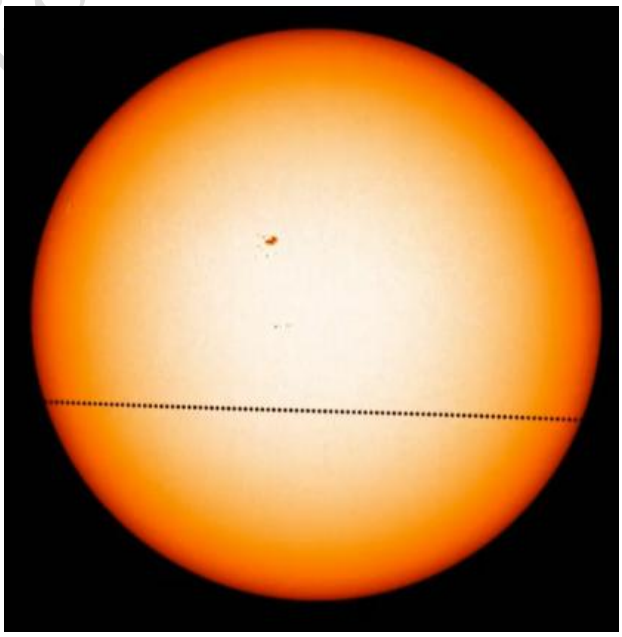
A transit of Mercury occurs when the planet Mercury passes between an observer and the Sun. It is then visible as a small black dot crossing the solar disk.

So the fact that this transit exists and is an easily observable fact is proof that the Earth is not flat, otherwise we could always see these local bodies above the flat Earth at an altitude lower than that of the Sun while having dimensions roughly equal to or greater than that of the Moon.

Here is a mosaic of the transit of Mercury on May 9, 2016, where approximately 7 hours and 30 minutes were needed to cross the entire solar disk (source : https://www.pbslearningmedia.org/resource/buac18-912-sci-ess-mercuryvenustransits/mercury-and-venus-transits/) :



Or superposed :



translation ongoing

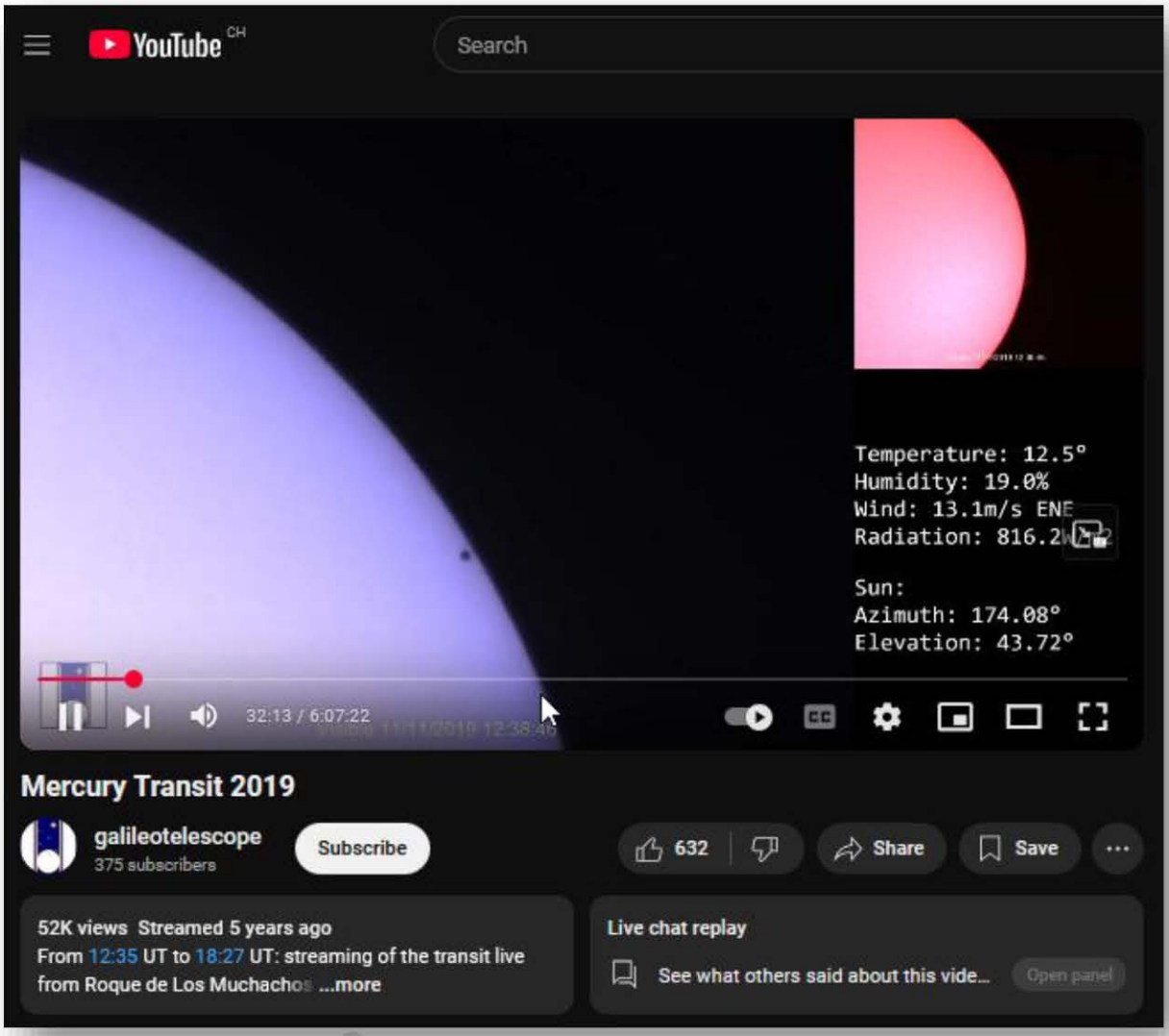
Or here below is a complete video of the transit with images every 30 seconds, shot with a 130 mm (5-inch) apochromatic refractor and a 2x Barlow lens to achieve an effective focal length of 1600 mm. Using a Canon 60Da camera with a cropped frame, the Sun's disk perfectly fills the frame (shots taken in Kamloops, BC/Canada):

https://www.youtube.com/watch?v=ojSpIT0TXlo

YouTube CH
Search
Transit of Mercury
May 9, 2016
Photographed from Kamloops, B.C. by Alan Dyer
with 130mm refractor (1600mm focal length) and Canon 60Da camera
0:00 / 6:39
Transit of Mercury May 9, 2016
AmazingSky
4.27K subscribers
Subscribe
4
Share
Save
164 views 8 years ago
My 6-minute video incorporates real-time (not time-lapse) footage of the transit of Mercury of Monday, May 9, 2016.
I shot video sequences in early morning, not long after sunrise and then again at the very end of the transit, at ...more

Or here below is a 6 hour and 7 minutes video of the entire transit of November 11, 2019:

https://www.youtube.com/watch?v=hUd6HgfqOv8



translation

Solar constant

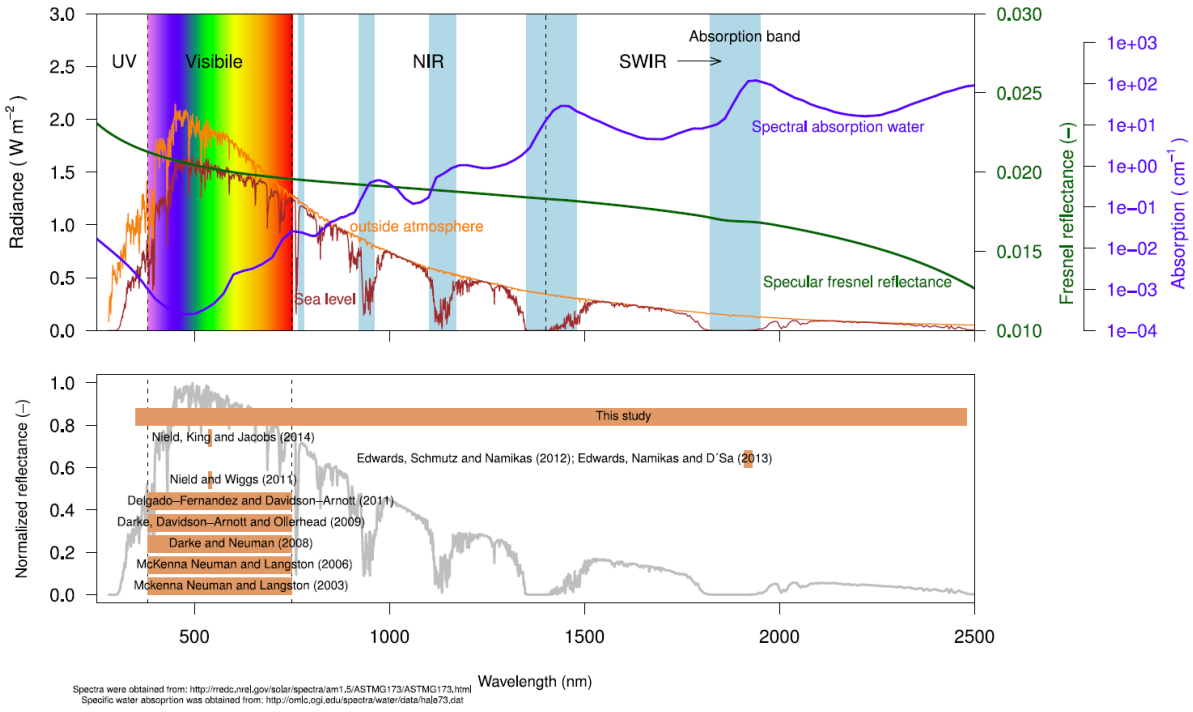
The solar constant is by definition the emittance of the Sun (that is to say its power per unit area), as received on average on Earth.

Given the very large difference in the Sun's dimensions and distances between the flat-Earth hypothesis and the oblate-Earth model, there must be considerable thermodynamic consequences. We will detail three major ones that render the flat Earth hypothesis obsolete:

1. The Earth's thermal equilibrium temperature
2. The Earth's diurnal temperature variation
3. The seasonal variation in Earth's temperature

(#170) Solar constant

The peak emittance of the Sun (peak of the blackbody spectrum) is at 490 nanometers (Measuring and Modeling the Effect of Surface Moisture on the Spectral Reflectance, 2014):



Using Wien's second law (Opera Magistris, 2024), which has never been proven wrong to date, we get:

$$T = \frac{897.8 \cdot 10^{-6}}{\lambda_{\max}} = 5\,900\ [\mathrm{K}]$$

Using the Stefan-Boltzmann law, we then have the following for the emittance:

$$M(T) = \sigma T^4 = \frac{2\pi^5 k^4}{15c^2h^3} T^4 \cong 6.87 \cdot 10^7 \ [\mathrm{W \cdot m^{-2}}]$$

Note that Wien's law and Stefan-Boltzmann's law have never been disproven by experimentation to date!

The Earth-Sun model, using astronomical distances measured by radar echo and LASER, and the Earth-Sun radius, or according to the method of Aristarchus of Samos (3rd century BC) (Opera Magistris, 2024), gives the following solar constant (Opera Magistris, 2024):

$$\Phi_{\mathrm{Sol.}} = \frac{\mathrm{P_{Sun}}}{4\pi R_{\mathrm{Earth}}} = \frac{4\pi R_{\mathrm{Sun}}^2 M(T)}{4\pi R_{\mathrm{Earth}}^2} \cong 1\,382 \ [\mathrm{W \cdot m^{-2}}]$$

In reality, it is measured at ground level that (Standard values for the solar constant and its spectral components, 1971) :

$$\Phi_{\mathrm{Sun}} = 1\,060 \ [\mathrm{W \cdot m^{-2}}]$$

So the model is close to reality.

Now, if we apply these same relationships to the flat-Earth model where, according to their claims, only the distance and radius of the Sun differ (distance 5,000 kilometers and radius 50 kilometers (Sun is a light 32 Miles Across, 1978)), we get the following solar constant:

$$\Phi_{\mathrm{Local\ Sun}} = \frac{\mathrm{P_{Sun}}}{4\pi R_{\mathrm{Earth}}} = \frac{4\pi R_{\mathrm{Sun}}^2 M(T)}{4\pi R_{\mathrm{Earth}}^2} \cong 36.45 \ [\mathrm{W \cdot m^{-2}}]$$

Which is very far from reality…

translation into english ongoing

(#171) Solar Constant and Thermal Equilibrium

Now that we have the solar constant, we can calculate the thermodynamic equilibrium temperature (Opera Magistris, 2024). In the globe model, we have:

$$T_S = \left(\frac{1}{\sigma} \frac{M_{\text{Sun}}(1-\rho)}{4} \frac{1}{\varepsilon_S - \frac{\varepsilon_S}{2}} \right)$$

Where for reminder, σ is the Boltzmann constant, ρ is the average albedo (reflection coefficient) of the Earth at the beginning of the 21st century, and ε_S is the emissivity (if equal to 1 then equivalent to a perfect black body) and ε_A is the back-radiation.

For the globe model, we have:

$$T_S = \left(\frac{1}{\sigma} \frac{1'382(1-\rho)}{4} \frac{1}{\varepsilon_S - \frac{\varepsilon_A}{2}} \right) \cong 297\ [\text{K}] \cong 14\ [\text{C}]$$

That's very realistic!

According to the flat Earth hypothesis, we have:

$$T_S = \left(\frac{1}{\sigma} \frac{36.45(1-\rho)}{4} \frac{1}{\varepsilon_S - \frac{\varepsilon_A}{2}} \right) \cong 125.3\ [\text{K}] \cong -147\ [\text{C}]$$

Therefore, the flat Earth hypothesis fails completely to explain the temperatures observed on Earth and the radiation measurements taken on the ground.

translation into english ongoing

(#172) Solar Constant and Daytime Temperature

At night, it is generally colder than during the day. The question now is whether the flat-Earth hypothesis adequately explains the temperature variation between the time the Sun appears on the horizon and the end of the day, and whether it compares to the spherical Earth model.

The diurnal temperature variation is given in the Earth-globe model by (Opera Magistris, 2024):

$$\Delta T_{\text{diurnal}} \cong \frac{g \cdot \frac{\frac{2\pi^5 k^4}{15c^2h^3}\left(\frac{2897.8 \cdot 10^{-9}}{\lambda_{\max}}\right) R_{\text{Sun}}}{d^2} \cdot (12 \cdot 60 \cdot 60)}{2P_0 e^{-\frac{gM(h-h_0)}{RT}} C_S} \cong 9.14\ [℃]$$

Which is quite in line with reality.

Whereas for the flat Earth hypothesis, if we consider that gravity does not exist (then $g = 0$):

$$\Delta T_{\text{diurnal}} \cong \frac{g \cdot \frac{\frac{2\pi^5 k^4}{15c^2h^3}\left(\frac{2897.8 \cdot 10^{-9}}{\lambda_{\max}}\right) R_{\text{Sun}}}{d^2} \cdot (12 \cdot 60 \cdot 60)}{2P_0 e^{-\frac{gM(h-h_0)}{RT}} C_S} \cong 0$$

What is obviously completely unrealistic. However, if we take $g = 9.81$ but $R_{\text{Sun}} \cong 50$ kilometers (as claimed by some proponents of the flat Earth without any proof (Sun is a light 32 Miles Across, 1978)), then we have:

$$\Delta T_{\text{diurnal}} \cong \frac{g \cdot \frac{\frac{2\pi^5 k^4}{15c^2h^3}\left(\frac{2897.8 \cdot 10^{-9}}{\lambda_{\max}}\right) R_{\text{Local Sun}}}{d^2} \cdot (12 \cdot 60 \cdot 60)}{2P_0 e^{-\frac{gM(h-h_0)}{RT}} C_S} \cong 0.00065629$$

Therefore, the flat Earth hypothesis is unable to explain diurnal variations, whereas the globe model is in very good agreement.

translation into english ongoing

(#173) Solar Constant and Seasons

As proved in detail in (Opera Magistris, 2024), temperature variations are given in the globe model by:

$$L_{\text{Sun}} = \frac{\sigma T^4 R^2 \cos(\theta)}{d^2} \cong \frac{4.468 \cdot 10^6 \cos(\theta)}{d^2}$$

And so at perigee/apogee, we have respectively:

$$L_{\text{Sun,per.}} \cong \frac{4.468 \cdot 10^6 \cos(\theta)}{d_{\text{per}}^2}$$

And :

$$L_{\text{Sun,app.}} \cong \frac{4.468 \cdot 10^6 \cos(\theta)}{d_{\text{ap.}}^2}$$

Hence :

$$\Delta L_D = 1 - \frac{L_{\text{Sun,app.}}}{L_{\text{Sun,per.}}} = 1 - \frac{d_{\text{ap.}}^2}{d_{\text{per}}^2} = 1 - \frac{(147\,098\,074\,000)^2}{(152\,097\,701\,000)^2} \cong 6.47\ \%$$

Therefore the distance from the Sun is not sufficient to explain the temperature variations between winter and summer. Let's now see if we consider only the Earth's axis of rotation. For example, in Switzerland at midday in summer, the Sun is at an angle of 68 degrees, and in winter at best at 22 degrees:

$$\Delta L_\theta = 1 - \frac{L_{\text{Sun,max.}}}{L_{\text{Sun,min}}} = 1 - \frac{\cos(\theta_{\max})}{\cos(\theta_{\min})} = 1 - \frac{\cos(68)}{\cos(22)} \cong 59\ \%$$

But that's not all that needs to be taken into account! We can prove that the length of the day at a given latitude λ for a given angle of inclination and a given date δ (recall that we associate with the date the angle δ traveled by the Earth in its orbit, from its position at the spring equinox) is given by the famous "equation of sunrise" (Opera Magistris, 2024):

$$\gamma = \left|-2\arccos\left(\tan(\lambda)\tan\left(\arcsin\left(\sin(23°27')\sin(\delta)\right)\right)\right)\right|$$

Thus, still for Switzerland, using the time equation, we find that the shortest day length (in winter) is approximately 8 hours and 30 minutes, and the longest day length (in summer) is approximately 16 hours. Therefore, we also have a day length ratio of:

$$\Delta t_{\text{diurnal}} = 1 - \frac{\left|-2\arccos\left(\tan(27°)\tan\left(\arcsin\left(\sin(23°27')\sin(270°)\right)\right)\right)\right|}{\left|-2\arccos\left(\tan(27°)\tan\left(\arcsin\left(\sin(23°27')\sin(90°)\right)\right)\right)\right|} \cong 46.75\ \%$$

So overall, due to the tilt, we can say that we have, as an approximation, a minimal decrease compared to the maximum brightness at the latitude of Switzerland:

$$\Delta L_{\text{tot.}} \cong 1 - (1 - 6.47\ \%)(1 - 59\ \%)(1 - 45.75\ \%) \cong 79.58\ \%$$

translation into english ongoing

This results in a total decrease of 79% between the hottest period of summer and the coldest period of winter. And this calculation is only a lower bound! More rigorous calculations would show that the actual decrease is greater than 79%!

We can see that the globe model explains seasonal temperature variations very well. In contrast, flat-Earthers have no coherent theoretical model!

If, however, just for fun, we take a local model of the Sun (where, according to them, the Sun is at its closest point 5,000 kilometers and at its furthest point 6,000 kilometers), as claimed by flat-Earth proponents, we have:

$$\Delta L_{\text{tot.flat}} \cong 1 - (1 - 1\,\%)(1 - 0\,\%)(1 - 45.75\,\%) \cong 46\,\%$$

This is obviously not at all in line with the observed reality!

translation into english ongoing

(#174) Time zones

Physical time zones (not to be confused with administrative time zones) are based on the rotation of the Earth, which is spherical.

Time zones cannot exist on a flat Earth since the Sun is always at a constant height above the flat Earth, according to flat Earth proponents…

Unless the sun's rays are bent as shown below:

http://walter.bislins.ch/bloge/index.asp?page=Flat+Earth+Dome+Model&state=--948.963616-131.558185-81-81-2

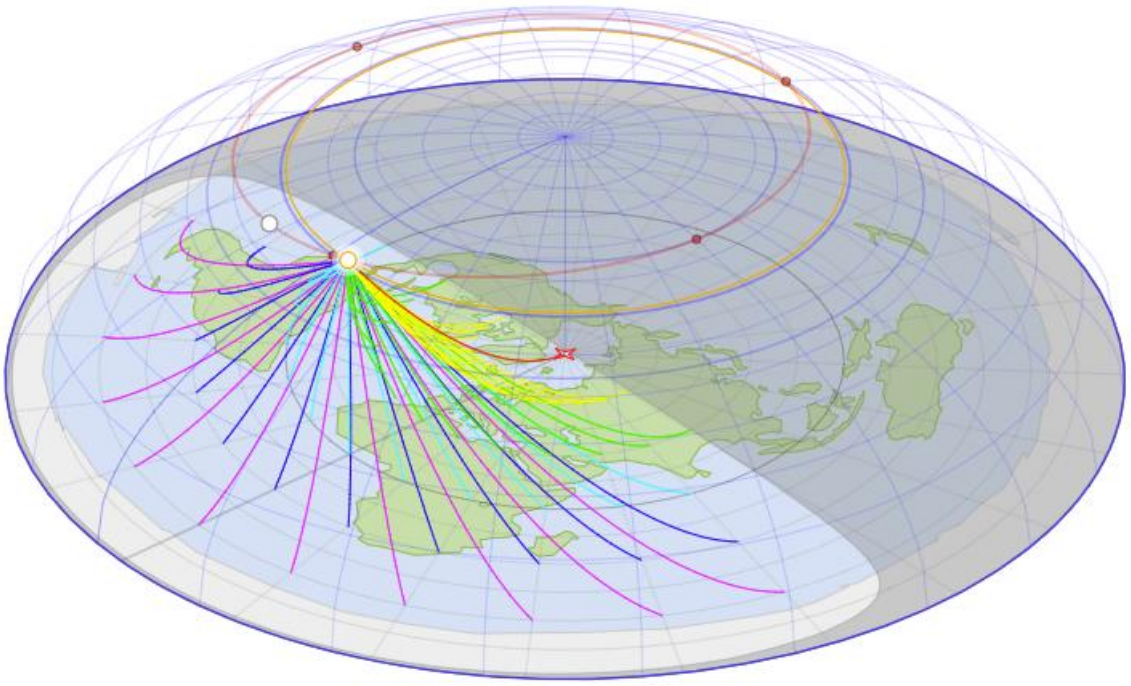


Figure 91 Curved beams of light and time zones on a flat Earth...

Anyone with a modicum of reason knows that this contradicts all known and proven laws of physics! Furthermore, forget trying to explain these light deflections due to refraction at the most distant points, because given the temperature gradient required at low altitudes, there would be constant deadly winds, making the Earth uninhabitable and temperatures far too extreme for humans to live on!

What flat-Earthers didn't learn at school (because most of them are homeschooled) is that time zones are:

1. A human invention, because in reality time zones should be infinitesimal.

2. They confuse administrative time zones with astronomical time zones.

That is why the Strasbourg clock (16th and 19th centuries) has two hands: one hand for astronomical time and one hand for administrative time!

Figure 92 Notre-Dame Clock in Strasbourg (France)

Here are the actual administrative (i.e. political) time zones on a globe:

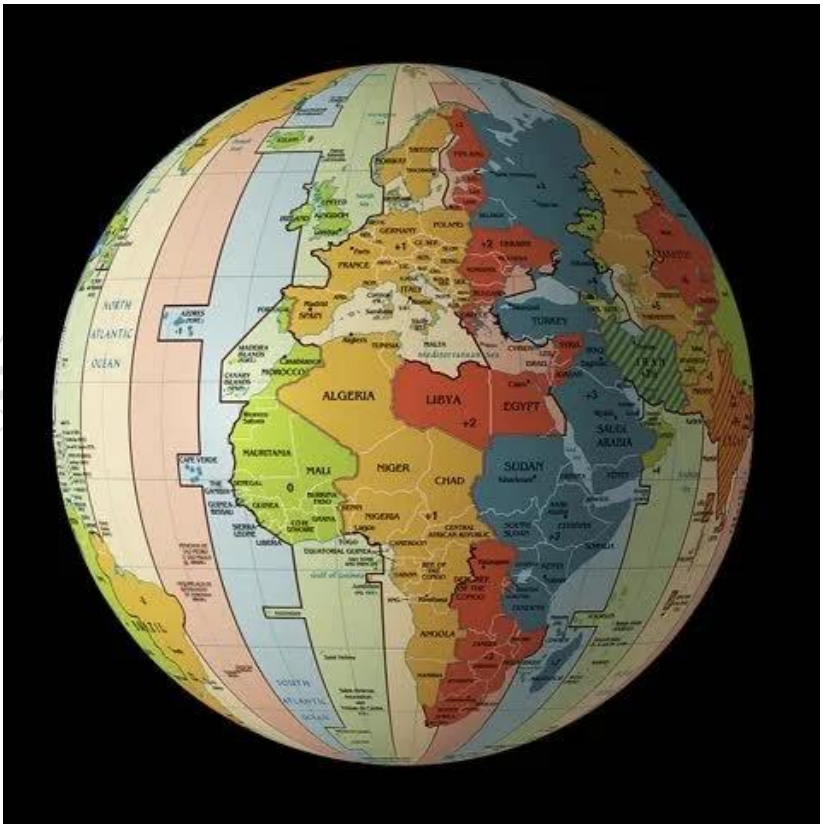


Figure 93 Administrative time zones illustrated on a globe (author: Serhii Bilyk, source: Shutterstock)

Artificial satellites

The flat Earth hypothesis poses several major problems when it comes to explaining the functioning of artificial satellites. Here are some key points:

1. **Satellite orbits:** Artificial satellites orbit the Earth thanks to gravity. In a flat Earth model, gravity would work differently, making it impossible to maintain satellites in a stable orbit.

2. **Global Coverage:** Geostationary satellites cover specific areas of the spherical Earth. In a flat Earth model, the arrangement and operation of these satellites would be inconsistent with actual observations of global coverage.

3. **Launch and trajectory:** Satellite launch trajectories are calculated based on the curvature of the Earth. A flat Earth would require completely different calculations and trajectories, which is not observed in reality (Opera Magistris, 2024).

4. **GPS and communications:** The GPS system and satellite communications depend on the position and movement of satellites around a spherical Earth. A flat Earth model could not explain the precise and reliable operation of these systems.

These inconsistencies show that the flat Earth hypothesis cannot satisfactorily explain the functioning of artificial satellites as we know them.

translation into english ongoing

(#175) Orbits problem

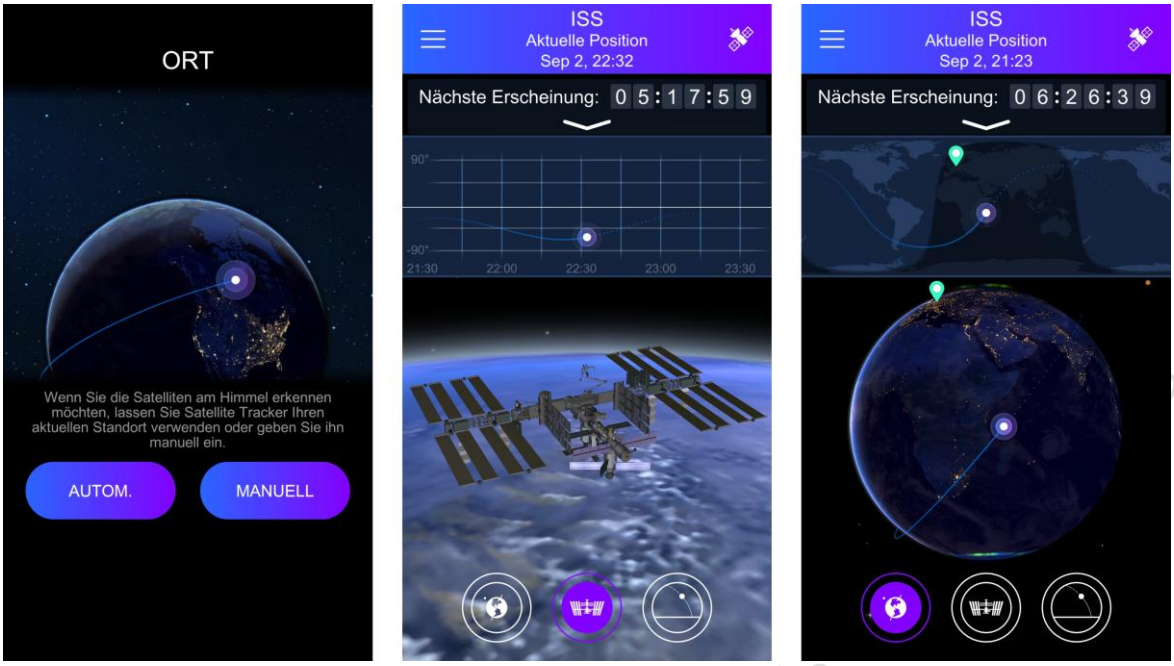
In the flat-Earth paradigm, a satellite does not revolve around the globe but above the Earth (…).

So admitting that there are satellites is admitting that the Earth is a globe and admitting that gravity exists (which the majority of flat-Earthers reject).

Below, we have the trajectory of the ISS if the Earth were flat, which is of course magical since it maintains its top speed at all times despite constant sharp turns…

Some artificial satellites are visible to the naked eye (except for those with myopia). Free online applications allow you to find out where and when to observe them in advance, such as the *Satellite Tracker* app on iOS:

translation ongoing


ORT
Wenn Sie die Satelliten am Himmel erkennen möchten, lassen Sie Satellite Tracker Ihren aktuellen Standort verwenden oder geben Sie ihn manuell ein.
AUTOM.
MANUELL
ISS
Aktuelle Position
Sep 2, 22:32
Nächste Erscheinung: 0 5 : 1 7 : 5 9
ISS
Aktuelle Position
Sep 2, 21:23
Nächste Erscheinung: 0 6 : 2 6 : 3 9

Lagrange points

And that's without even mentioning the non-existence of Lagrange points in the flat-Earth hypothesis, even though there are several artificial observation satellites located there, such as the James Webb Telescope, precisely because the Earth is not flat and the Sun and Moon are not located above its flat surface:

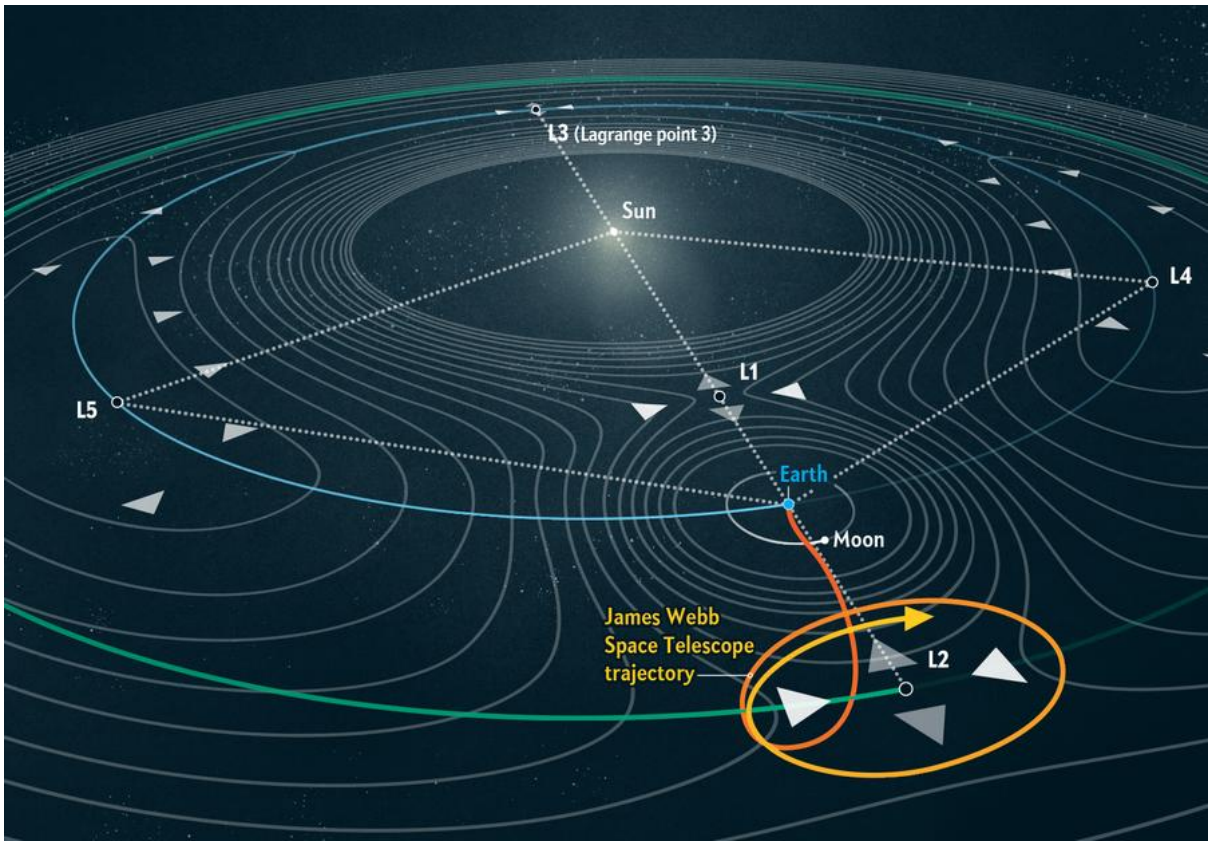


Figure 94 The five Lagrange points in the Sun-Earth-Moon triplet (author: Matthew Twombly)

Here is an illustration of the observation satellites currently positioned over two of these Lagrange points:

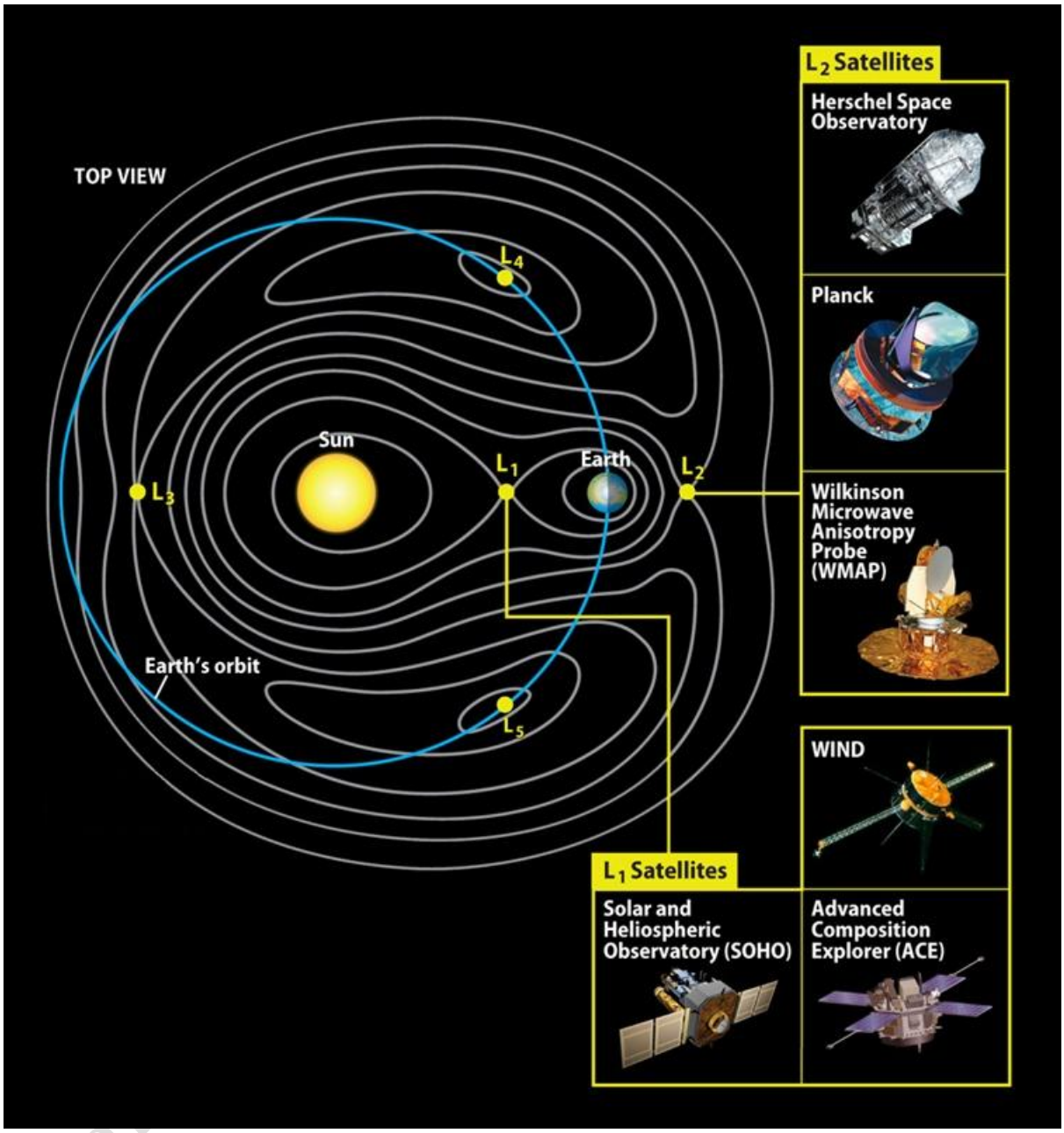


Figure 95 Observation satellites at Lagrange points L1 and L2 (source: Astronomy/Royen Kelly)

If the reader wants a detailed mathematical derivation of the positions of the 5 Lagrange points, see (Opera Magistris, 2024).

Geostationary satellites

Geostationary satellites pose an insurmountable problem with a flat Earth because proponents of the flat Earth have no coherent physical-mathematical model to explain why satellites are visible and fixed in the night sky with telescopes (or in good conditions they can even be seen with the naked eye).

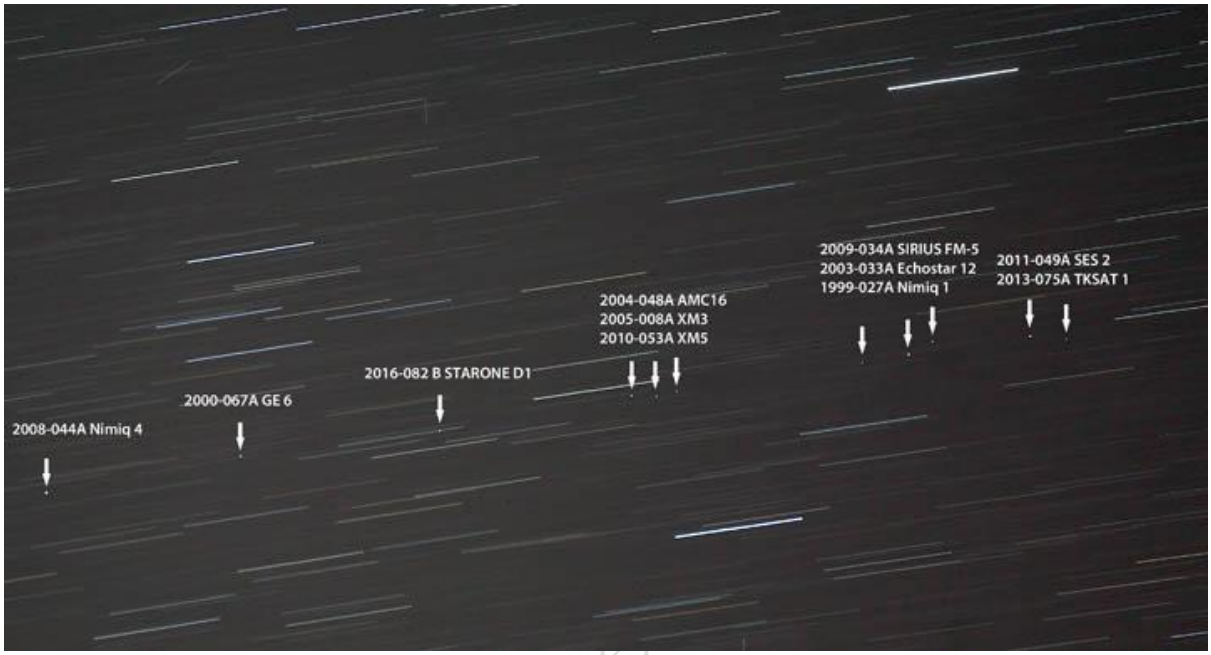


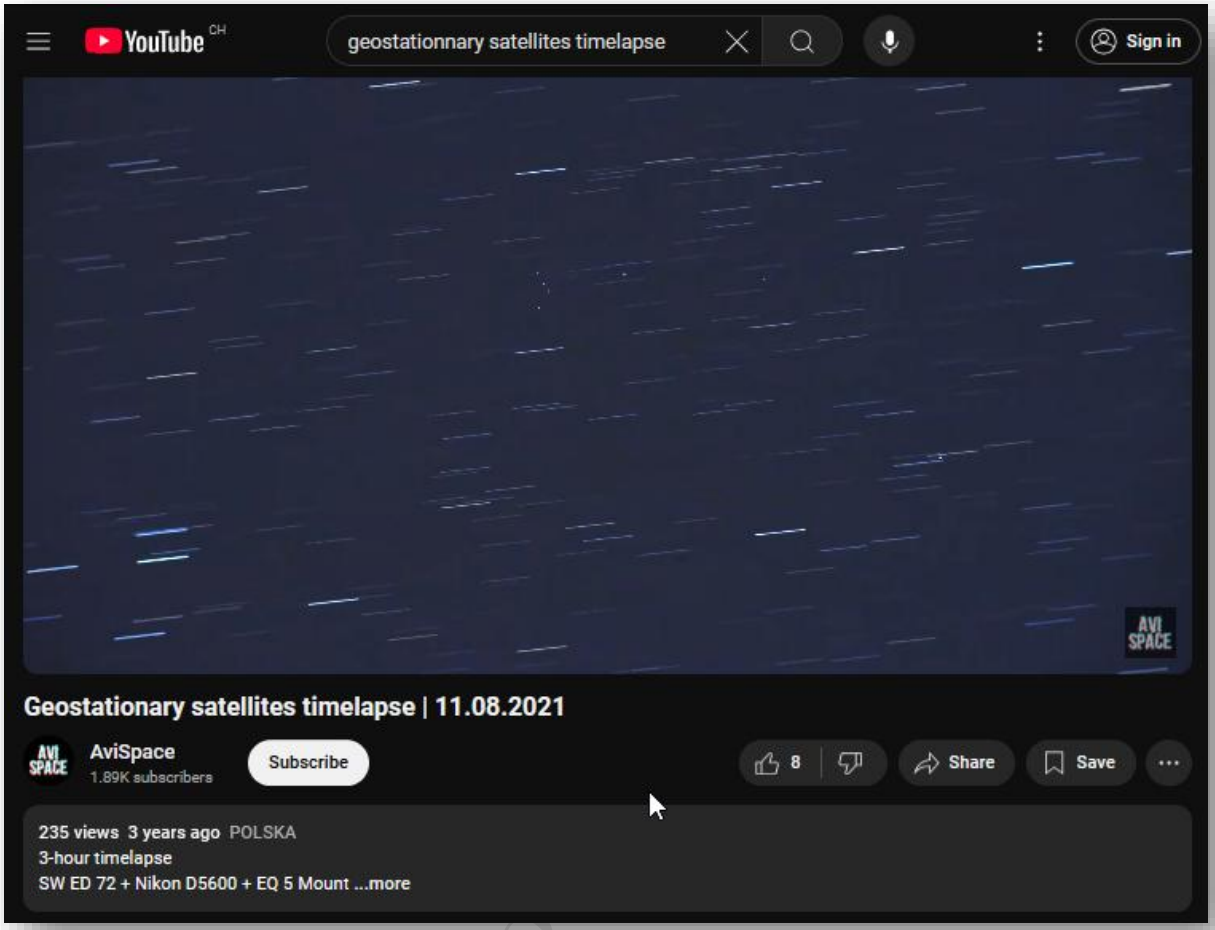
Figure 96 Geostationary satellites (author Bob King, source: Sky & Telescope)

Above is a composite image taken on September 11 at 10:50 PM CDT, created with a 3-minute exposure of the center of Aquarius and capturing 11 geosynchronous satellites. Nimiq-4 is a Canadian satellite for digital television services. XM-3 provides digital audio for cars and homes, and TKSAT-1 is Bolivia's first communications satellite.

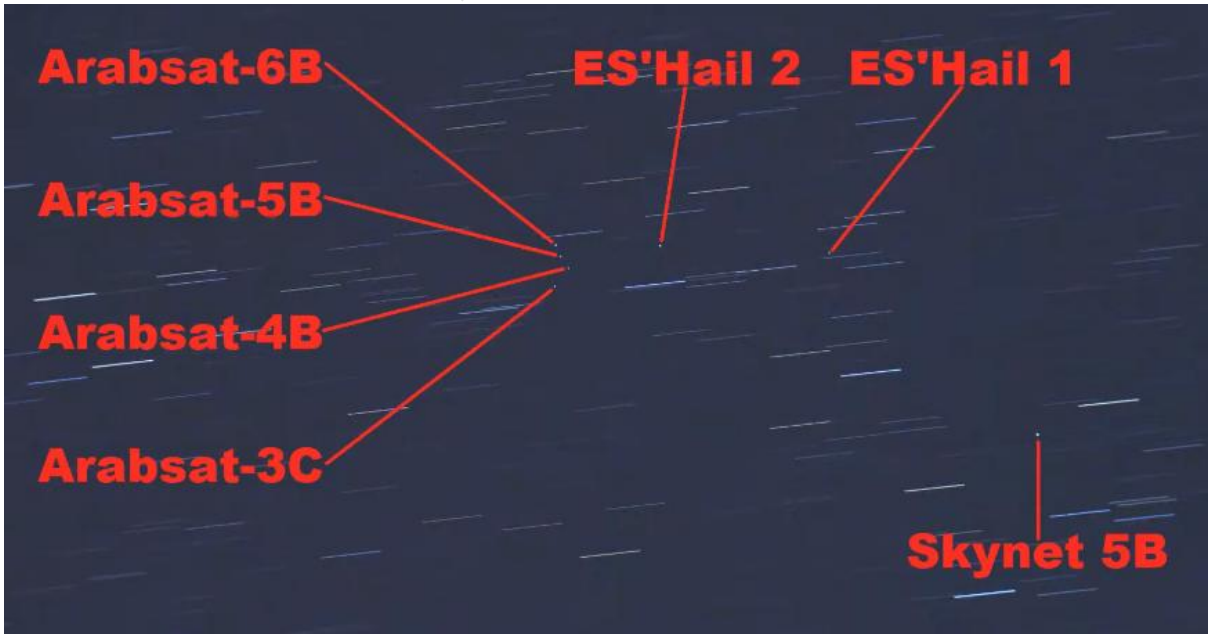
Here is a link to a first video of a 3-hour timelapse shot with a SW ED 72 + Nikon D5600 + EQ 5 Mount:

https://www.youtube.com/watch?v=XDbeq8XFOA4

translation in progress

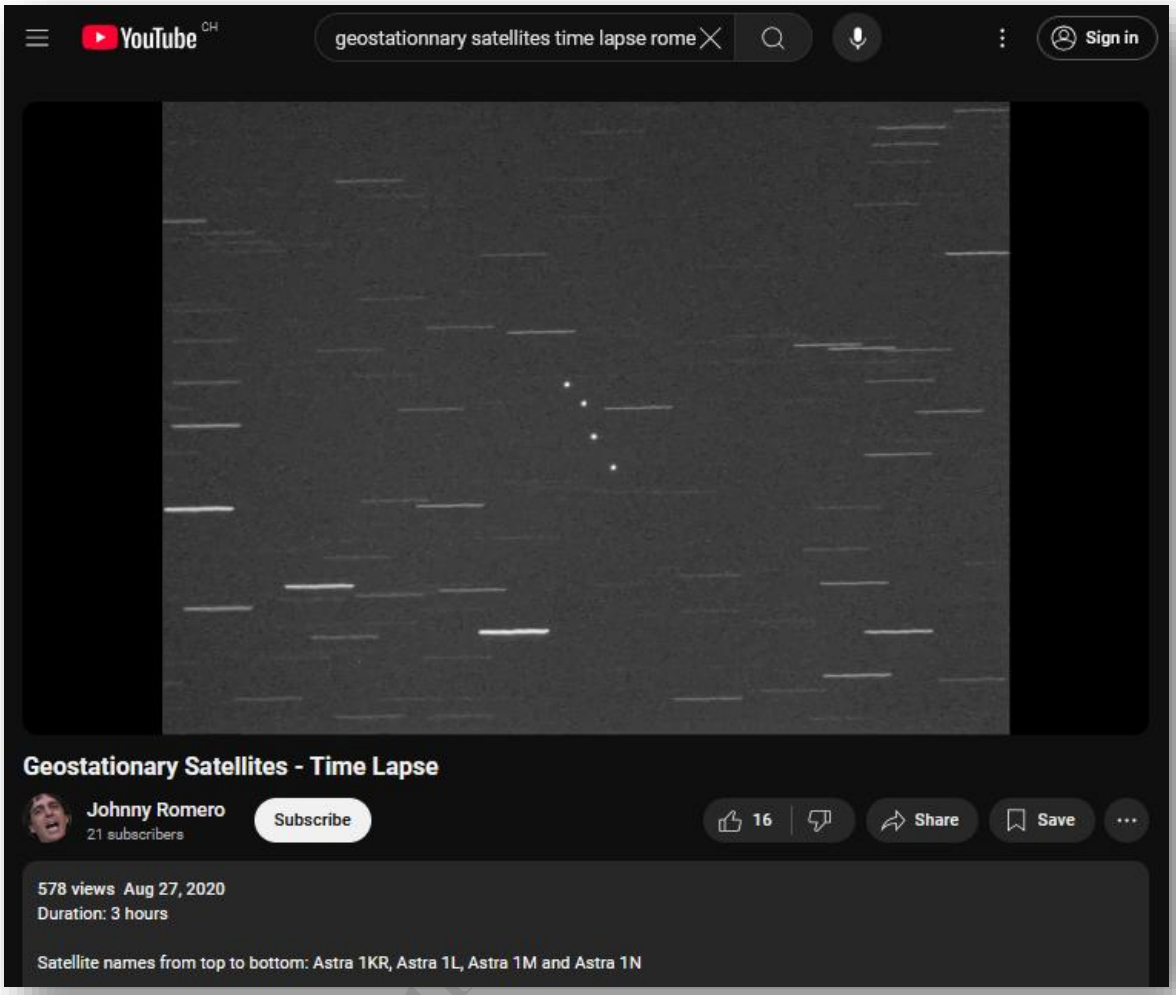


The visible geostationary satellites are:



And a second video (just for your viewing pleasure):

https://www.youtube.com/watch?v=OqT6y2Qv0SA



So keep in mind that flat Earth proponents are unable to explain nor to model this simple, verifiable, controllable, and repeatable observation…!

translation

(#176) G.P.S. (Global Positioning System)

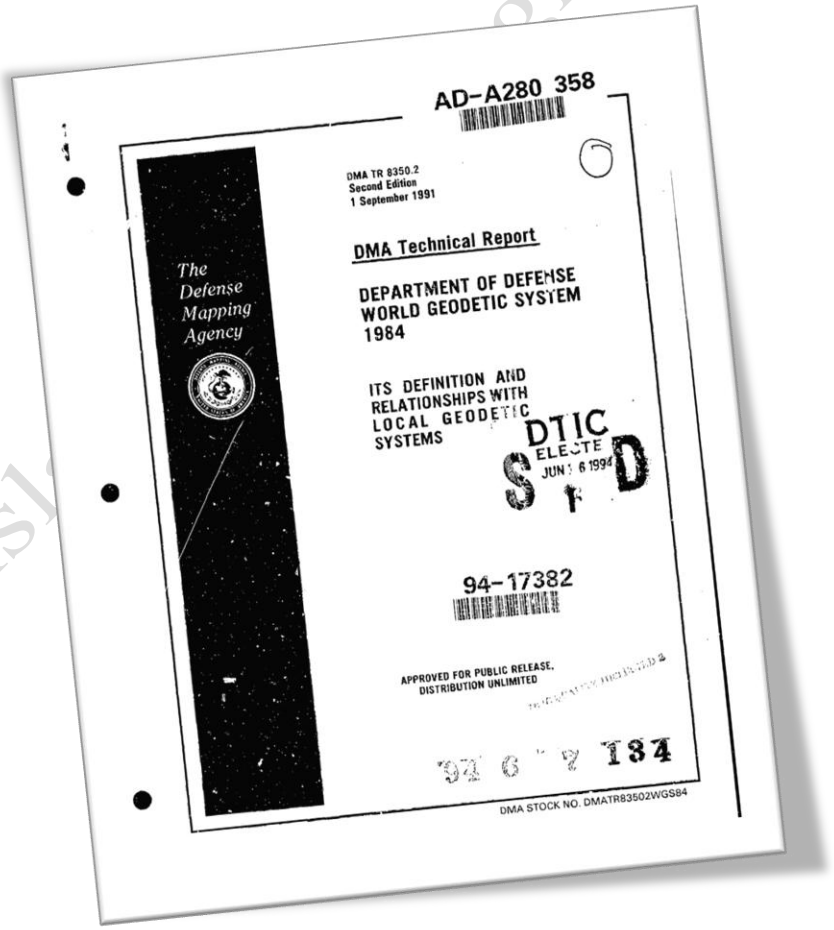
The aim here is not to use the argument of the impossible orbits of the satellites of the European, American or other GPS system because that was the subject of the previous "proof" but to talk about the standard used by the GPS system.

The mathematics of navigation using Global Positioning System (GPS) satellites assume that these satellites move in known orbits around an approximately spherical surface. The fact that GPS uses the WGS84 (World Geodetic System 1984) reference ellipsoid for the conversion between NED (North-East-Down) and LLA (Latitude, Longitude, and Altitude) coordinates is another normative factual evidence that the Earth is not flat!

The World Geodetic System (WGS) is a standard used in cartography, geodesy, and satellite navigation, including GPS. The current version, WGS84, defines a fixed, centered Earth coordinate system and a geodetic datum, and also describes the associated Earth Gravitational Model (EGM) and World Magnetic Model (WMM). The standard is actually published and maintained by the U.S. National Geospatial-Intelligence Agency.

The PDF of the standard is available here:

https://apps.dtic.mil/sti/pdfs/ADA280358.pdf


AD-A280 358

DMA TR 8350.2
Second Edition
1 September 1991

The Defense Mapping Agency

DMA Technical Report

DEPARTMENT OF DEFENSE WORLD GEODETIC SYSTEM 1984

ITS DEFINITION AND RELATIONSHIPS WITH LOCAL GEODETIC SYSTEMS

DTIC ELECTE JUN 16 1994 S F D

94-17382

APPROVED FOR PUBLIC RELEASE, DISTRIBUTION UNLIMITED

94 6 7 184

DMA STOCK NO. DMATR83502WGS84

We have in it at page 3-1:

3. WGS 84 ELLIPSOID

3.1 General

In geodetic applications, three different surfaces or earth figures are normally involved. In addition to the earth's natural or physical surface, these include a geometric or mathematical reference surface, the ellipsoid, and an equipotential surface called the geoid (Chapter 6). In determining the WGS 84 Ellipsoid and associated parameters, the WGS 84 Development Committee, in keeping with DMA guidance, decided quite early to closely adhere to the thoughts and approach used by the International Union of Geodesy and Geophysics (IUGG) when the latter established and adopted Geodetic Reference System 1980 (GRS 80) [*]. Accordingly, a geocentric equipotential ellipsoid of revolution was taken as the form for the WGS 84 Ellipsoid. The parameters selected to define the WGS 84 Ellipsoid are the semimajor axis (a), the earth's gravitational constant (GM), the normalized second degree zonal gravitational coefficient ($\bar{C}_{20}$) and the angular velocity (ω) of the earth (Table 3.1). These parameters are identical to those of the GRS 80 Ellipsoid with one minor exception. The coefficient form used for the second degree zonal is that of the WGS 84 Earth Gravitational Model rather than the notation J_2 used with GRS 80. Accuracy estimates (one sigma) are also included in Table 3.1 for the defining parameters.

3.2 Defining Parameters

3.2.1 Semimajor Axis (a)

The semimajor axis (a) was selected as one of the defining parameters of the WGS 84 Ellipsoid. Its adopted value and estimated accuracy (one sigma) are:

$$a = 6378137 \pm 2 \text{ meters.} \qquad (3\text{-}1)$$

(#177) Anomaly in stereoscopic topographical measurements

The French space agency CNES (Centre National d'Études Spatiales) launched the SPOT 1 satellite in 1986 into a Sun-synchronous polar orbit, meaning it orbits the poles and maintains a constant angle relative to the Sun, while the Earth rotates below it. This brought any point on the Earth's surface into the imaging field beneath the satellite every 26 days. SPOT 1 took multiple photographs of areas of the Earth during different orbital passes, from various locations in space. These images could then be analyzed to match features and triangulate distances to points on the ground, essentially forming a stereoscopic image of the Earth's surface. This reveals the height of topographic features: hills, mountains, and so on.

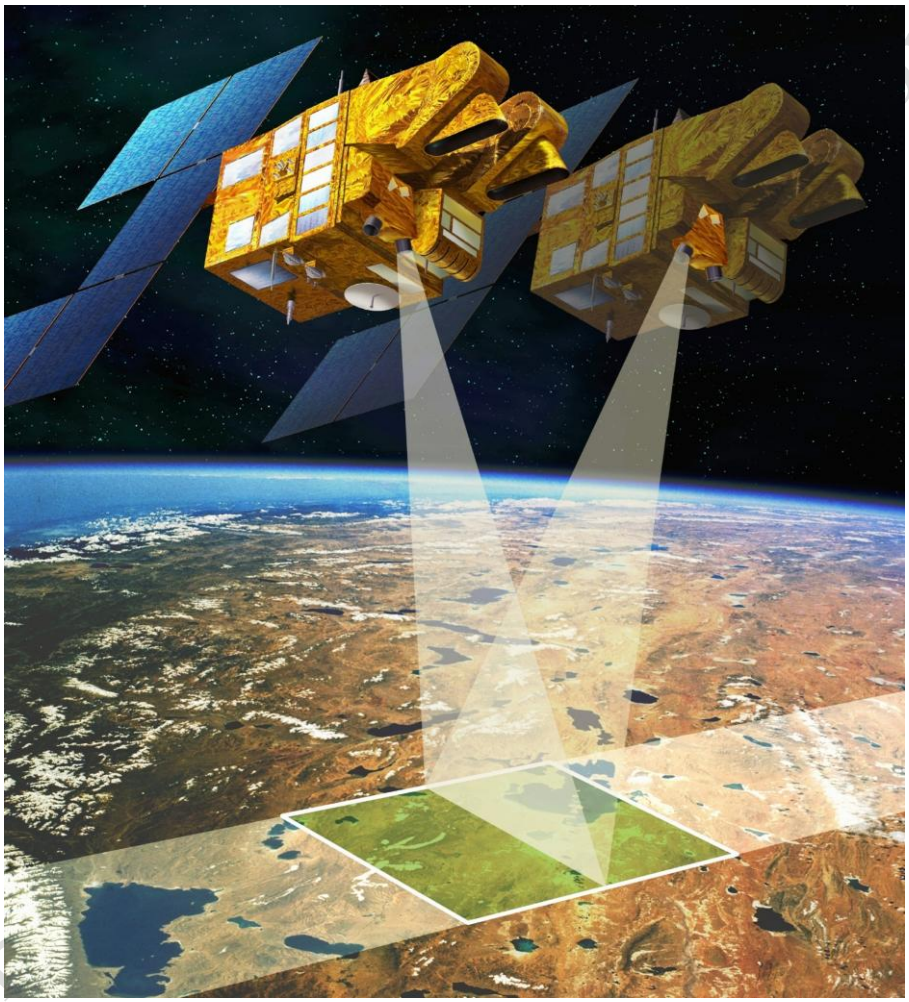
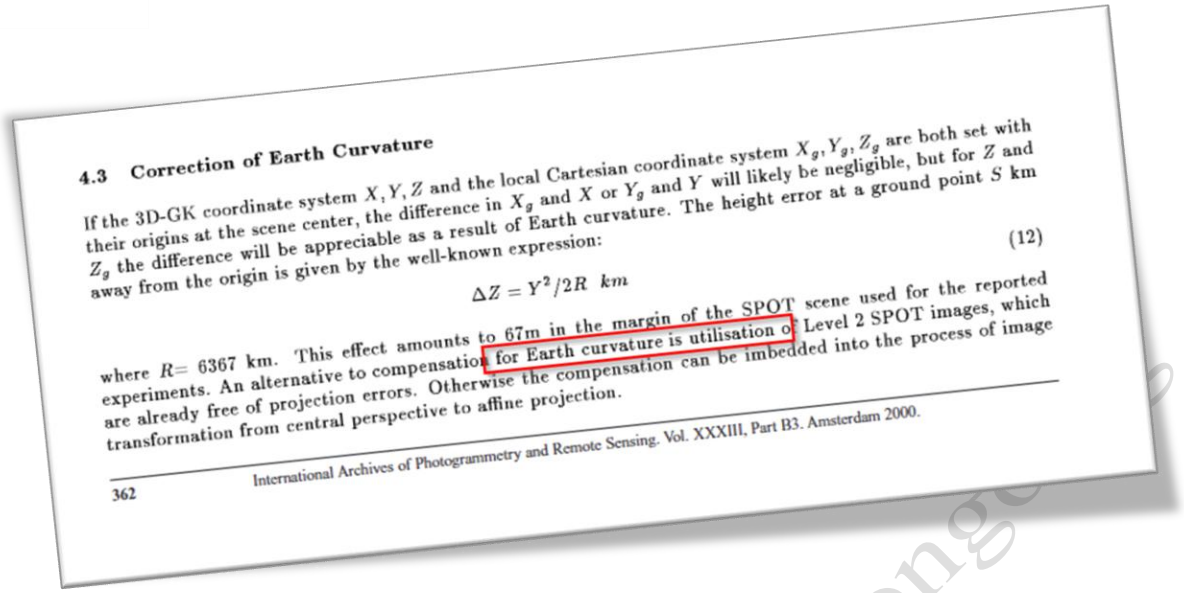


Figure 97 Principle of stereoscopic measurement with a SPOT satellite

However, the deduction of stereoscopic heights does not correspond to the measurement on the ground due to the curvature of the Earth (see voir (Orientation of high-resolution satellite images based on affine projection, 2000)):



4.3 Correction of Earth Curvature

If the 3D-GK coordinate system X, Y, Z and the local Cartesian coordinate system X_g, Y_g, Z_g are both set with their origins at the scene center, the difference in X_g and X or Y_g and Y will likely be negligible, but for Z and Z_g the difference will be appreciable as a result of Earth curvature. The height error at a ground point S km away from the origin is given by the well-known expression:

$$\Delta Z = Y^2/2R \quad km \tag{12}$$

where R= 6367 km. This effect amounts to 67m in the margin of the SPOT scene used for the reported experiments. An alternative to compensation for Earth curvature is utilisation of Level 2 SPOT images, which are already free of projection errors. Otherwise the compensation can be imbedded into the process of image transformation from central perspective to affine projection.

362 International Archives of Photogrammetry and Remote Sensing. Vol. XXXIII, Part B3. Amsterdam 2000.

A correction has been indeed added to counteract the curvature of the Earth!

translation into english ongoing

Moon

We will focus here on evidence for an oblate Earth related to the Moon. There are indeed a number of problems with the hypothesis of flat Earth proponents and the Moon.

(#178) Shape of the Moon's shadow during lunar eclipses

There are many problems with the flat Earth hypothesis and lunar eclipses.

Indeed, remember that in the flat Earth hypothesis, there are only two celestial bodies above the flat Earth: the Sun and the Moon (the others planets doesn't exist in their fiction…).

Figure 98 On the left, the appearance of a lunar eclipse on a hypothetical flat Earth. On the right, what actually happens (credit: JL Dauvergne).

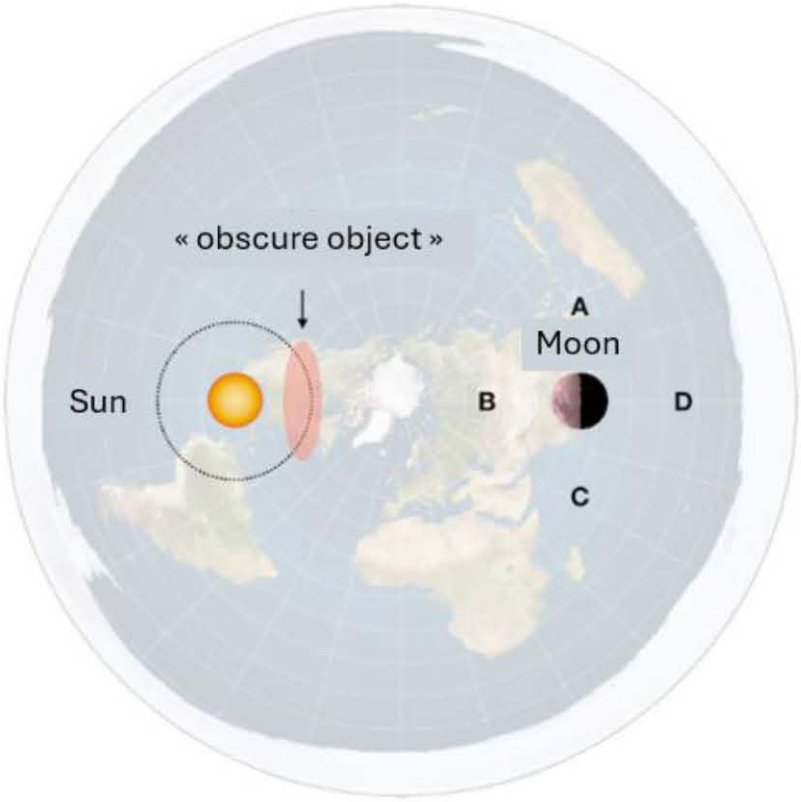
The problem is that in the flat Earth proponents' hypothesis, the Sun and Moon are always above the flat Earth.

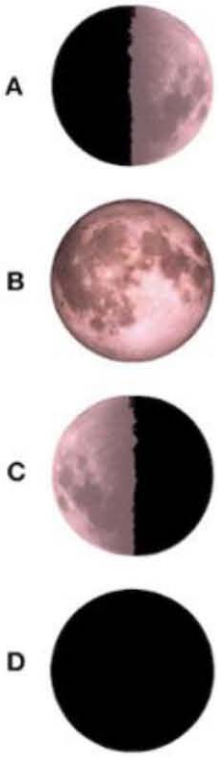
So here's what debunks the flat Earth theory with this simple observation:

- Oblate umbra: During a lunar eclipse, the Earth casts its shadow on the Moon. This shadow is always circular, which is only possible if the Earth is spherical. If the Earth were flat, the shadow cast would have different shapes depending on the angle of the light.

- Existing shadow: If the Sun and Moon are always above the flat Earth there should never be a lunar eclipse.

According to the *Flat Earth Society*, here is a diagram of what a lunar eclipse on a flat Earth would look like. However, from different locations, a different eclipse would be visible. Furthermore, points A and C are not visible during existing eclipses, which further refutes their hypothesis.



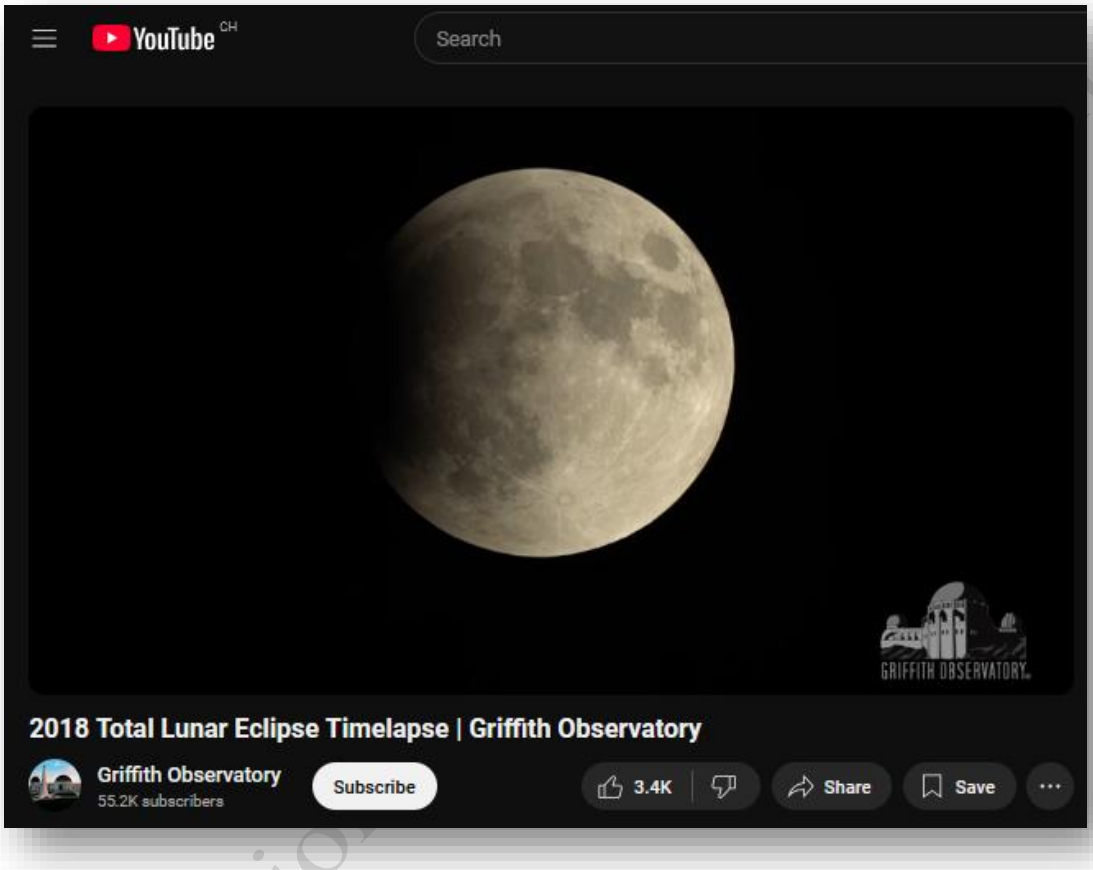


translation into en

(#179) Origin and color of the shadow during lunar eclipses

The visible shadow cannot be interpreted as the unlit portion of a hypothetical distant Sun that never disappears below the horizon… because the lunar eclipse is visible to the naked eye, and we see it occur in just a few hours. For a better understanding, the reader can refer to the following video (approximately 4 hours sped up to 60 seconds):

https://www.youtube.com/watch?v=buXTecdfqxo



Furthermore, the change in color tone is incompatible with observing the usual phases of the Moon on a flat Earth. The reddish tint comes from the diffraction of light by the Earth's atmospheric layers located between the Moon and the Sun.

translation pending

Figure 99 During a total lunar eclipse, the Moon appears to turn red as it passes through the Earth's shadow (photo credit: Anantha Jois via Getty Images)

translation into englis

(#180) Variation in the apparent size of the Moon

If the Moon is local (remember that this hypothesis is imposed by proponents of the flat Earth), its variation in apparent size would be significant and easily measurable!

In reality, we have a current apparent size variation of approximately 12% between the closest and furthest points of the orbit:

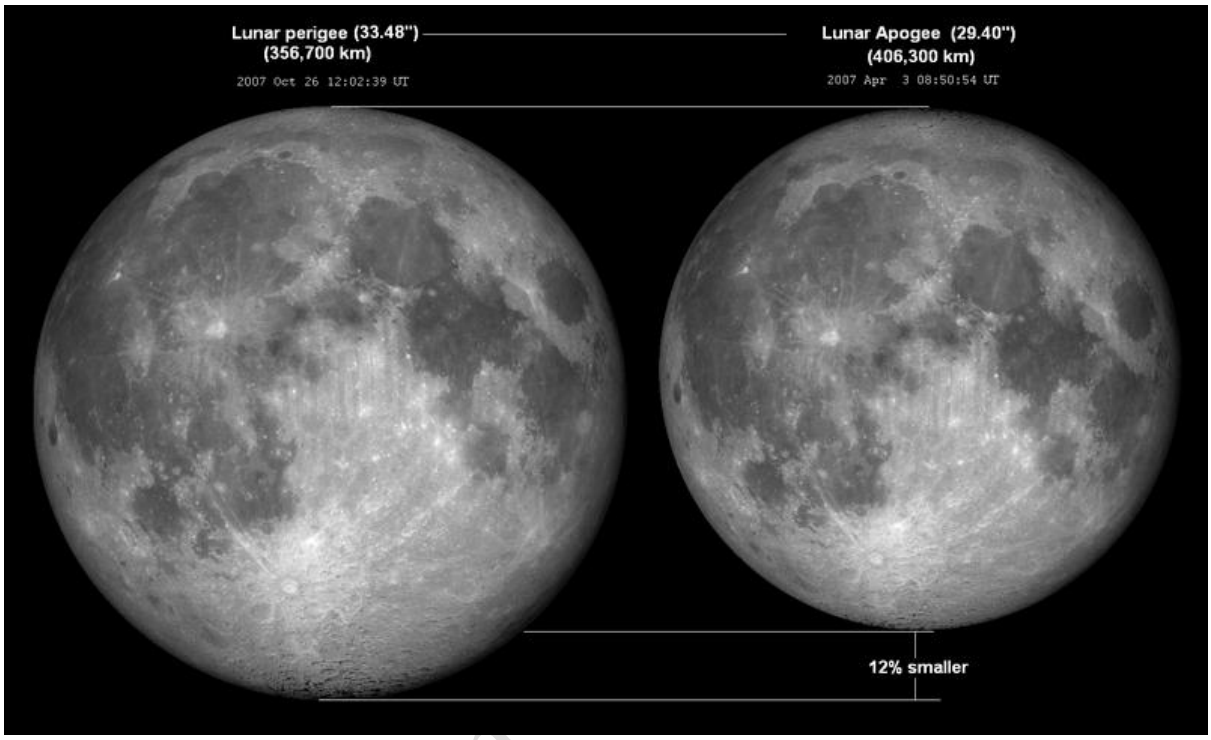
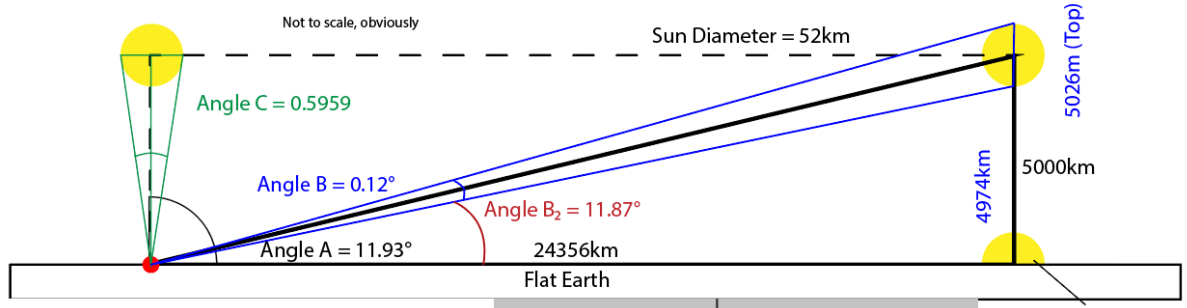


Figure 100 Variation in apparent size of the Moon (source: Wikipedia)

Whereas on a flat Earth, since according to flat-Earthers the Moon is about 5,000 kilometers high and about 50 kilometers in diameter (roughly the same dimensions and height as the Sun in an attempt to explain solar eclipses which in reality proponents of the flat Earth completely fail to model and predict accurately), by doing the same calculations that we had done for the Sun (voir page 301):

translation in



$$Angle\ A: \tan\left(\frac{5000}{24356}\right) = Sun's\ angle\ above\ horizon\ at\ furthest\ distance$$

$$Angle\ B: \tan\left(\frac{5026}{24356}\right) - \tan\left(\frac{4974}{24356}\right) = Sun's\ size\ expressed\ as\ an\ arc\ at\ furthest\ distance$$

$$Angle\ C: 2\left(\tan\left(\frac{26}{5000}\right)\right) = Sun's\ size\ expressed\ as\ an\ arc\ at\ noon$$

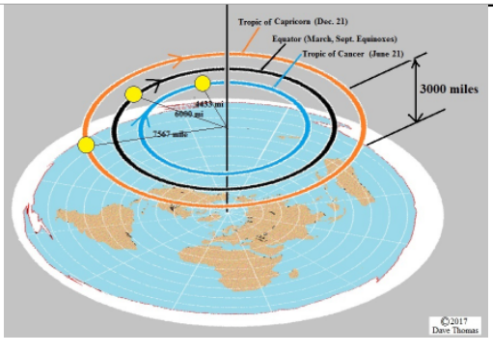
$$Angle\ A: \tan\left(\frac{5000}{24356}\right) = 11.93°$$

$$Angle\ B: 2\left(\tan\left(\frac{26}{5000}\right)\right) = 0.5959°$$

$$Angle\ C: \tan\left(\frac{5026}{24356}\right) - \tan\left(\frac{4974}{24356}\right) =$$

$$Angle\ C: 11.99° - 11.87° = 0.12°$$

Assumes sun diameter at ~52km



0 degree view at sunset - 26km of the sun imbedded in the ground

By the Flat Earth Hypothesis most widely accepted model, accounting for "Perspective", at it's widest orbit, the sun would alway be visible at least 11 degrees above the horizon.

By this model, due to the "perspective" claim, the sun would also be visibly 5x smaller at this point than at noon.

We therefore have a variation of 0.12° in the angular size of the Moon (approximately 10%) within the framework of the flat-Earth proponents' hypothesis, compared to 12% observed in reality. Once again, the flat-Earth proponents' hypothesis does not conform to reality.

Furthermore… if the flat-Earthers' hypothesis respected the laws of perspective, we would have:

In the flat Earth hypothesis, the distance to the Moon varies throughout the day. The Moon's constant apparent size proves that the Earth is not flat and that the Moon is very far away.

(#181) Accuracy of lunar eclipse predictions

Lunar eclipses occur predictably and regularly. Eclipse prediction models are based on a spherical Earth and Moon and a heliocentric system, as demonstrated in detail in (The Saros cycle: obtaining eclipse periodicity from Newton's laws, 2009).

These models do not work accurately over the medium term (on the order of a few thousand years) because the solar system is a chaotic system on the long term.

In the model with a globe, the approximate numerical mathematical relationship between two lunar eclipses is given by (for years between 2005 and 2050):

$$\Delta T = 62.92 + 0.32217 \cdot \left(\text{year} + \frac{(\text{month} - 0.5)}{12} - 2000\right) + 0.005589 \cdot \left(\text{year} + \frac{(\text{mois} - 0.5)}{12} - 2000\right)^2$$

Formally, based on Newtonian mechanics (The Saros cycle: obtaining eclipse periodicity from Newton's laws, 2009), Saros cycles[7] are the least common multiple of:

$$T_S = \frac{T_0 T_y}{T_y - T_0} = 29.530589 \text{ days (synodic month, exact value)}$$

$$T_d = \frac{T_0}{1 + \frac{3T_0^2 \cos(\beta)}{4T_y^2}} \cong 27.207946 \text{ days (lunar month, error of 0.016\%)}$$

$$T_a = T_0\left(1 + \frac{3T_0^2}{2T_y^2}\right) \cong 27.550969 \text{ days (anomalous month, error of 0.013\%)}$$

where T_0 is the Moon's orbital period in the frame of reference of stars considered to be fixed in a first approximation and equal actually to 27.321662 days and T_y is the Earth's sidereal year equal actually to 365.2555636 days, β is the angle of inclination of the lunar orbit which cannot exist on a flat Earth…

The Saros cycle is the least common multiple (T_S, T_d, T_a).

The Saros' cycle calculation appears to be a simple however non-trivial way to explore various mathematical techniques such as asymptotic expansions and homogenization. The fact that the final results depend only on the ratio between the sidereal month and year and the inclination of the ecliptic - two dimensionless numbers - is no surprise to anyone who has observed the night sky. Furthermore, let's keep in mind that the proof naturally leads to the rejection of the flat Earth hypothesis.

However :

[7] The name "Saros" was applied to the eclipse cycles by Edmond Halley in 1691 and the Saros series numbering system by van den Berh in 1955.

translation into english ongoing

- The Saros cycle cannot predict the duration and accuracy of eclipses to the second.
- The Saros cycle cannot predict the path of totality of a solar eclipse.
- It is not possible with the Saros cycle to calculate two different types of eclipses without changing the Saros series. Therefore, the Saros model is not consistent.
- The Saros series lacks continuity because when one series ends, there will be no further eclipses within that series, as the model is not robust.
- It is not possible to predict the first eclipse in a Saros series of a Saros cycle on its own.

All these shortcomings of the Saros series and cycles exist because reality is much more complex and can be calculated correctly only with computer simulations by injecting many data from past observations and are only valid in the medium term because the solar system is not perfectly stable.

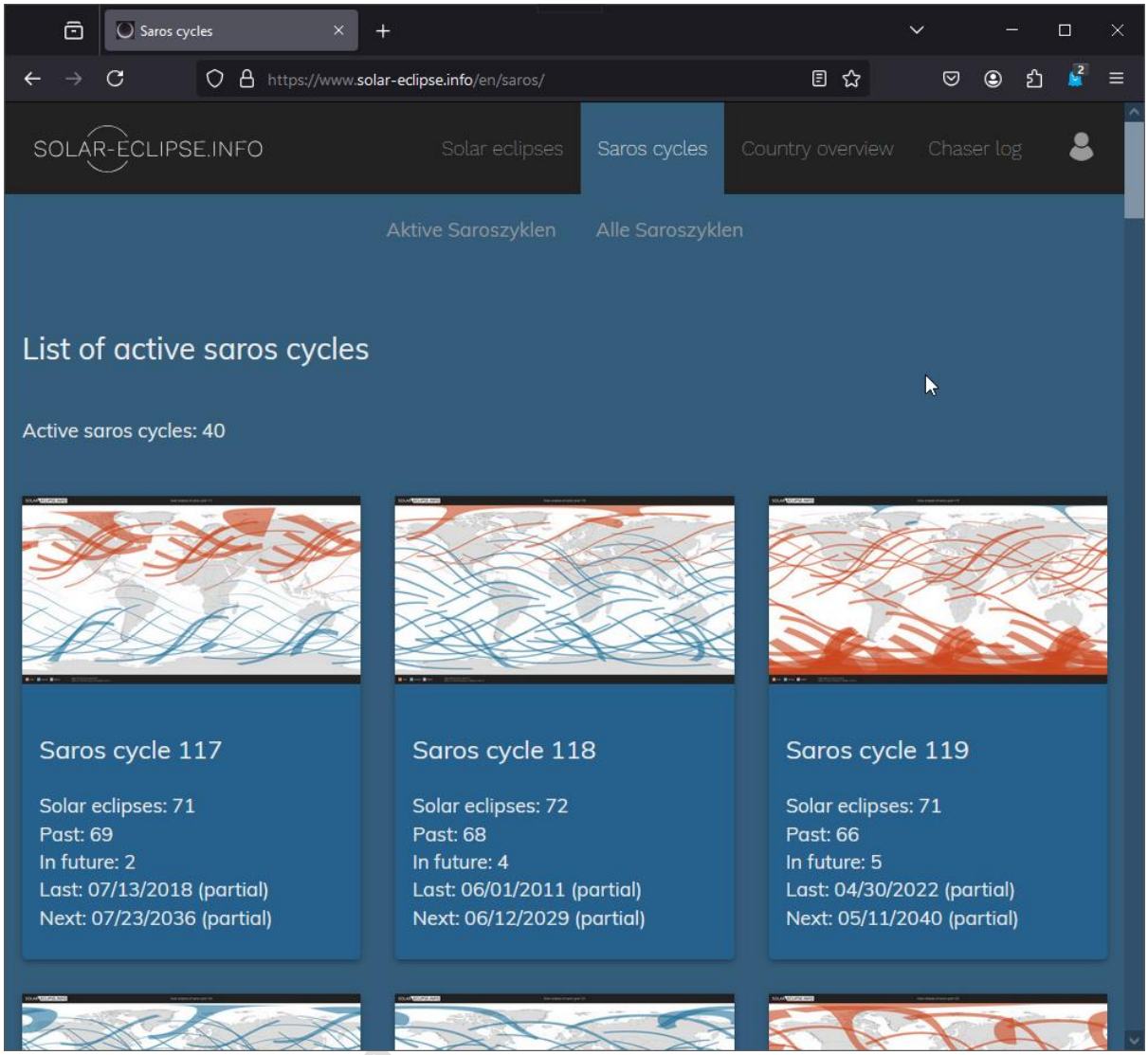
To account for the nuances mentioned above, the Saros model is unsuitable, and the VSOP87 model must be used for the Sun's coordinates (Planetary theories in rectangular and spherical variables-VSOP 87 solutions), and the ELP-2000/82 model for the Moon coordinates (The lunar ephemeris ELP 2000, 1983). The revised value used for the Moon's secular acceleration is $\dot{n} = -25.858\ [\text{arcsec} \cdot \text{cyc}^2]$, as deduced from LASER measurements of the Earth-Moon distance made thanks to retroreflectors deployed by the Apollo missions (A new determination of lunar orbital parameters, precession constant and tidal acceleration from LLR measurements, 2002).

To see why the Saros cycles model is a jungle (mess), see the website:

https://www.solar-eclipse.info/en/saros/

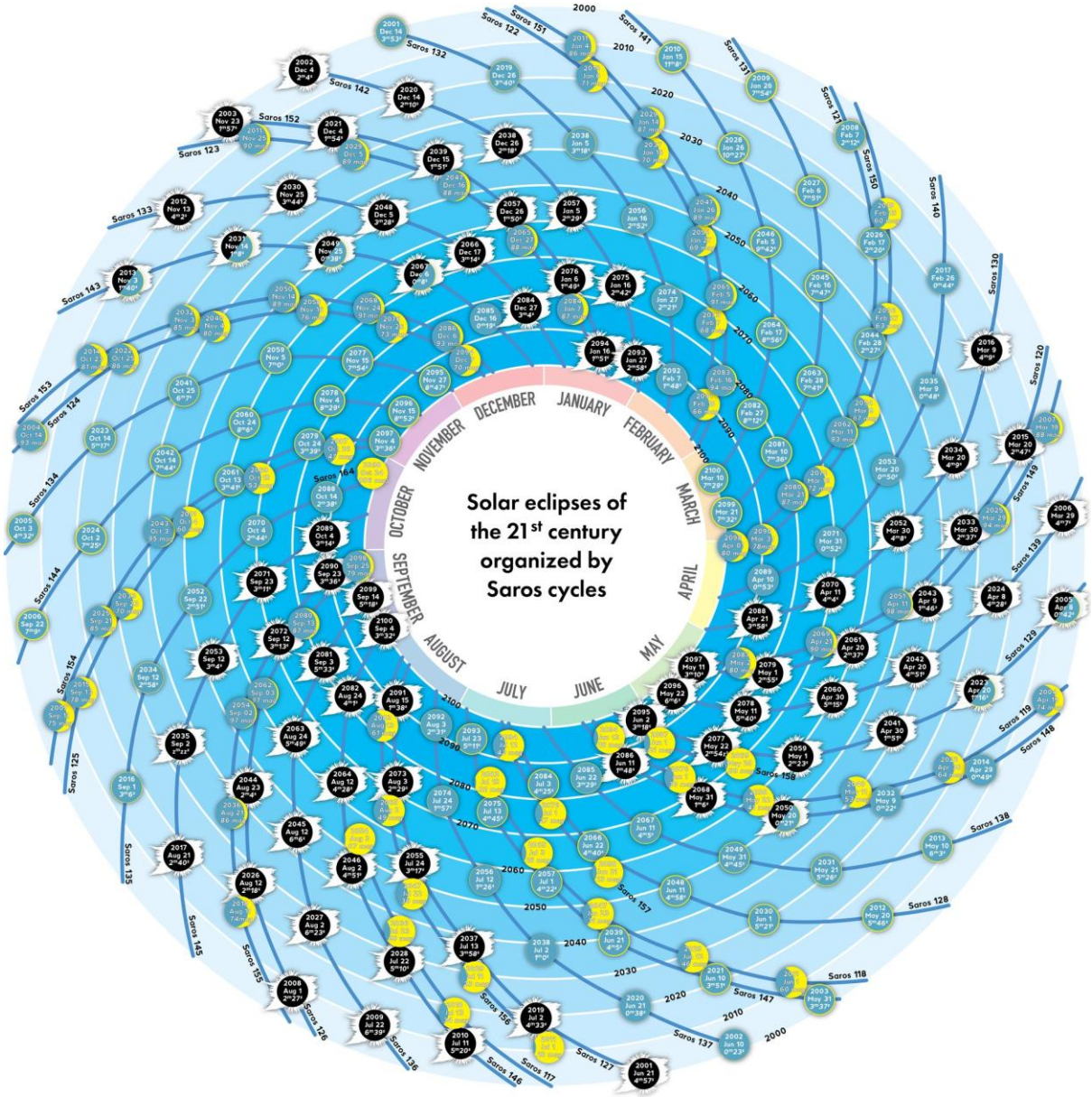
which references dozens of Saros series:

translation into english ongoing

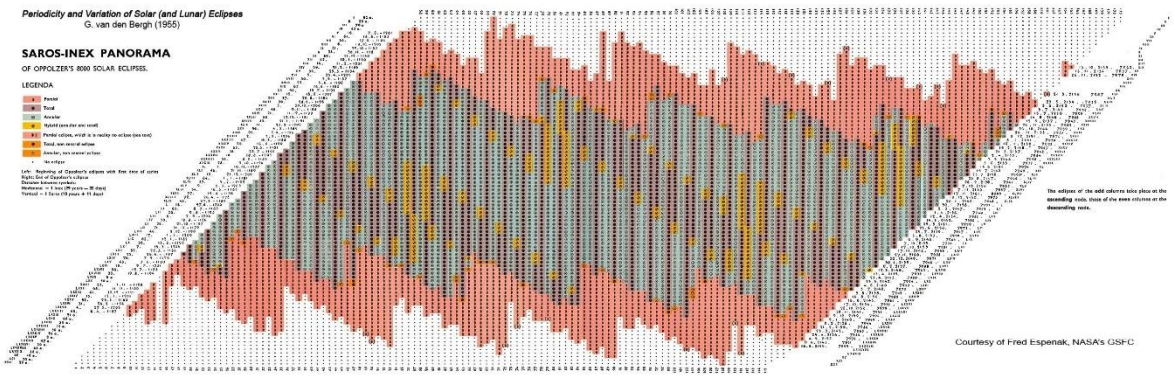


Or, in a summarized way (it is crystal clear that the model is not satisfactory):

translation



We see that the Saros series are irregular and not generalized, as can be seen below:


Periodicity and Variation of Solar (and Lunar) Eclipses
G. van den Bergh (1955)
SAROS-INEX PANORAMA
OF OPPOLZER'S 8080 SOLAR ECLIPSES.
LEGENDA
Courtesy of Fred Espenak, NASA's GSFC

(#182) Lunar Eclipse observation points

Lunar eclipses are visible from different parts of the world. If the Earth were flat, eclipse observations would be inconsistent from one place to another.

Here, for example, is the surface where the Moon was visible during the lunar eclipse of January 21, 2019 at 5:14 AM GMT (maximum of the eclipse):

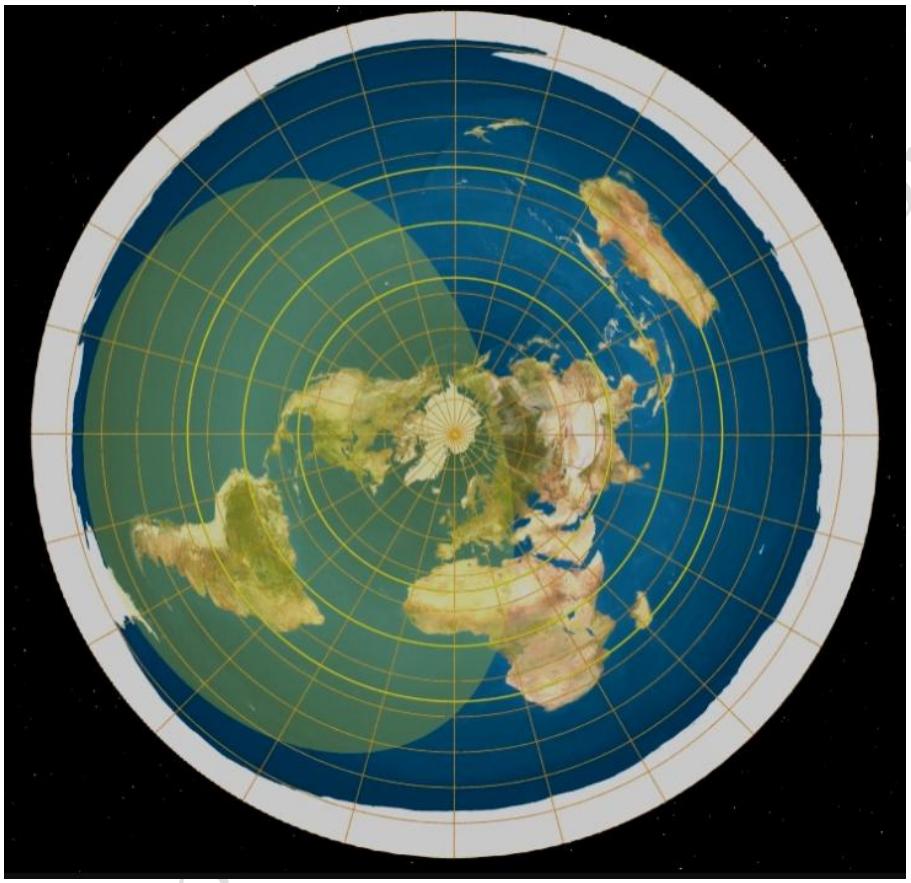


Figure 101 Maximum visibility of the January 2019 lunar eclipse (author: Jos Leys)

Next, a website like www.timeanddate.com gives us the following for Amsterdam (direction 275°, altitude 21°):

translation

Time	Phase	Event	Direction	Altitude
03:36 ma 21 jan		Penumbral Eclipse begins The Earth's penumbra start touching the Moon's face	242°	43.5°
04:33 ma 21 jan		Partial Eclipse begins Partial moon eclipse starts - moon is getting red	255°	35.5°
05:41 ma 21 jan		Total Eclipse begins Total moon eclipse starts - completely red moon.	269°	25.6°
06:12 ma 21 jan		Maximum Eclipse Moon is closest to the center of the shadow	275°	21.0°
06:43 ma 21 jan		Total Eclipse ends Total moon eclipse ends	280°	16.5°
07:50 ma 21 jan		Partial Eclipse ends Partial moon eclipse ends. Moon close to horizon, so make sure you have free sight to West-northwest	292°	7.0°
08:48 ma 21 jan		Penumbral Eclipse ends The Earth's penumbra ends. Since the Moon is near the horizon at this time, we recommend going to a high point or finding an unobstructed area with free sight to West-northwest for the best view of the eclipse.	303°	0.0°

How to use altitude & direction to find in the sky

This total lunar eclipse was fully visible in Amsterdam. The total lunar eclipse is sometimes called a blood moon, as the Moon turns red.

And if we take other locations and transfer the observation vectors according to the given angles, we get the following on a flat Earth:

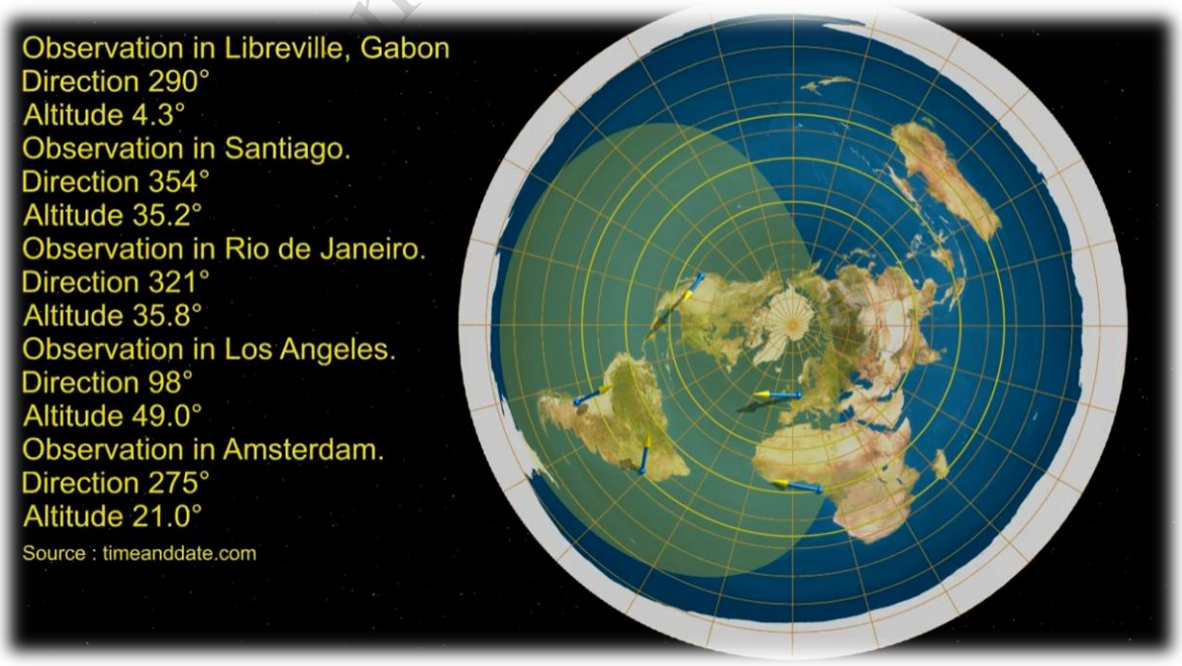


Figure 102 Directional vectors for observing the January 2019 lunar eclipse (author: Jos Leys)

If we extrapolate these vectors we encounter a problem… they do not intersect at a single point (we know why since the flat Earth map is a projection of the Earth and therefore requires the shape of Moon and the Sun to be distorted everywhere…!)

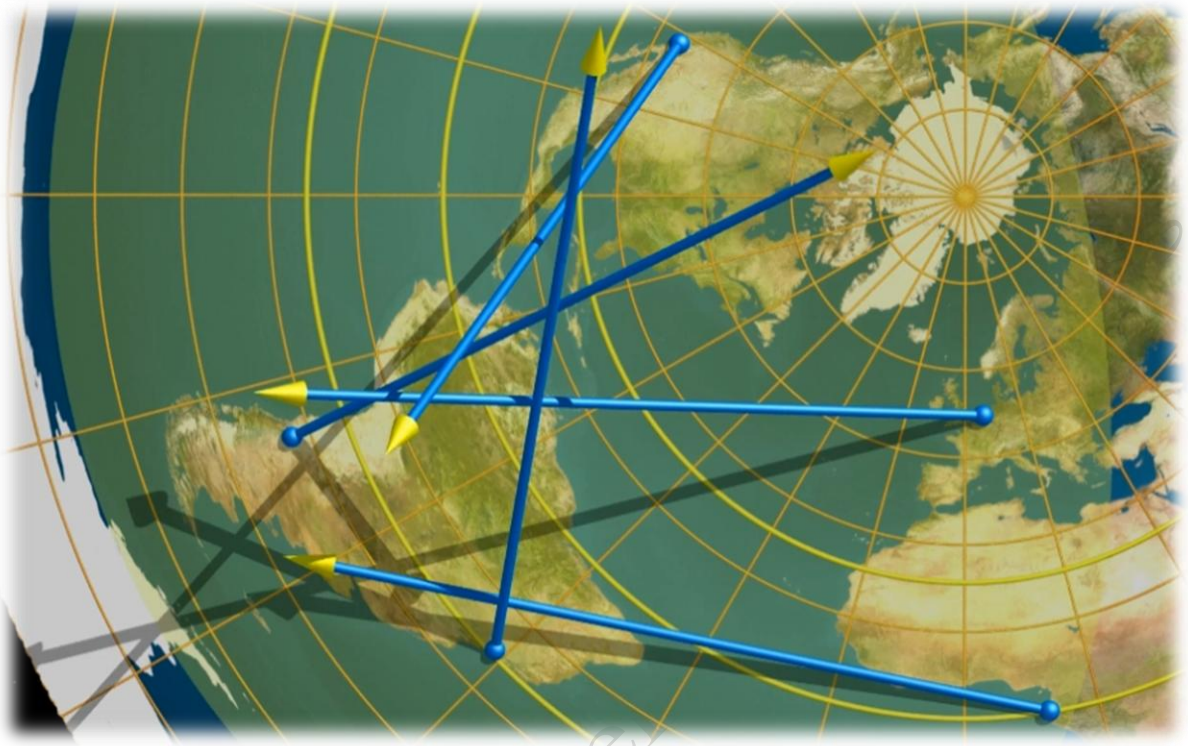


Figure 103 Extension of the observation direction vectors of the January 2019 lunar eclipse (author: Jos Leys)

These points show that lunar eclipses are incompatible with a flat Earth and strongly support the model of a spherical Earth where the direction is aligned with a lunar body several hundred thousand of millions kilometers away:

translation in e

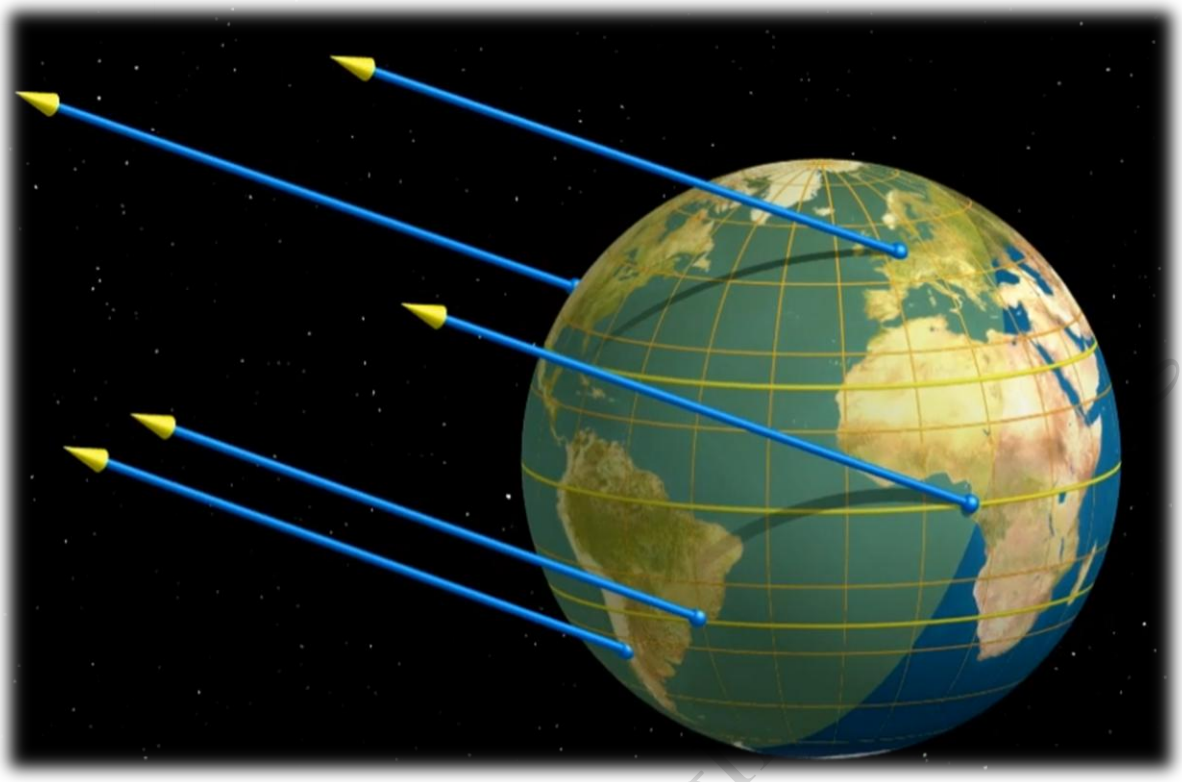


Figure 104 Extension of the observation direction vectors onto a globe of the January 2019 lunar eclipse (author: Jos Leys)

Let's take a moment to address the Saros predictions that flattards often cite as an argument. Indeed, predicting eclipses with acceptable accuracy does not require the Saros cycle or NASA's involvement. In fact, Saros predictions are inaccurate (with errors of several kilometers, i.e., 0.02%, as demonstrated in (The Saros cycle: obtaining eclipse periodicity from Newton's laws, 2009)) and do not hold true over several thousand years. Furthermore, the Saros cycle model is based on a spherical Earth and a heliocentric model.

Using current computing power, eclipse prediction is generally done iteratively. The following Python script searches for occurrences of a lunar eclipse during the 21st century:

```python
#!/usr/bin/env python
import ephem   # using the ephemeris data from pyephem
from datetime import datetime, timedelta
curtime = datetime(2001, 1, 1, 0, 0, 0)
endtime = datetime(2100, 12, 31, 23, 59, 59)
moon = ephem.Moon()
sun = ephem.Sun()
observer = ephem.Observer()
observer.elevation = -6371000     # earth's center
observer.pressure = 0             # disable refraction
while curtime <= endtime:
    observer.date = curtime
    moon.compute(observer)
    sun.compute(observer)
    sep = abs((float(ephem.separation(moon, sun))
        / 0.01745329252) - 180)  # get separation in degrees
    if sep < 0.9: # if eclipse occurs, hardcoded for simplicity
        print(curtime.strftime('%Y/%m/%d%H:%M:%S'), sep)
        curtime += timedelta(days = 1)   # advance a day
    else:
        curtime += timedelta(hours = 1)  # advance an hour
```

Updates may be available in the GitHub repository:

https://github.com/flatearthws/eclipse-calculations

The script uses Pyephem (https://rhodesmill.org/pyephem) to determine the positions of the Moon and the Sun. Use "pip install pyephem" to install it on your system. The Pyephem source code is available to everyone here: https://github.com/brandon-rhodes/pyephem. Feel free to examine it and check if it uses the Saros cycle (spoiler alert... it doesn't).

The raw script output is shown here:

```
15  2012/06/04 11:00:00 0.8399758317970623
16  2014/04/15 07:00:00 0.482251667258339
17  2014/10/08 10:00:00 0.6428411736380326
18  2015/04/04 11:00:00 0.6151052787245419
19  2015/09/28 02:00:00 0.5780768427848102
20  2017/08/07 18:00:00 0.8187726096424512
21  2018/01/31 13:00:00 0.4218638345480201
22  2018/07/27 19:00:00 0.6265613780881836
23  2019/01/21 04:00:00 0.8078094913612688
24  2019/07/16 21:00:00 0.6368296591879528
25  2021/05/26 11:00:00 0.522460304817713
26  2021/11/19 08:00:00 0.6292692078108644
27  2022/05/16 03:00:00 0.7367146725525231
28  2022/11/08 10:00:00 0.5421172820840638
29  2025/03/14 06:00:00 0.5542252994482908
30  2025/09/07 17:00:00 0.7155927229167105
31  2026/03/03 10:00:00 0.8808068606197992
32  2026/08/28 03:00:00 0.7589382103219862
33  2028/07/06 18:00:00 0.7501027218099807
34  2028/12/31 16:00:00 0.5547546695825929
35  2029/06/26 02:00:00 0.7451512165108909
36  2029/12/20 21:00:00 0.87293882334194
37  2030/06/15 18:00:00 0.8337070314567541
38  2032/04/25 14:00:00 0.7030416560137098
39  2032/10/18 18:00:00 0.7230008947566091
40  2033/04/14 18:00:00 0.6598088911721618
41  2033/10/08 10:00:00 0.6217812087752179
42  2035/08/19 01:00:00 0.8749422644245328
43  2036/02/11 21:00:00 0.7668233167542837
44  2036/08/07 01:00:00 0.8591282569779821
45  2037/01/31 13:00:00 0.6977449206751771
46  2037/07/27 03:00:00 0.7459421319968556
```

Compare it to the list of 21st-century lunar eclipses on the website of Wikipedia or NASA.

Detailed modern mathematical developments for predicting solar eclipses are available on pages 542 to 549 in dans (A Manual of Spherical and Practical Astronomy: Spherical astronomy, 1874). The reader can verify there that the Earth is considered spherical and the heliocentric model is used for the simple reason that a detailed and robust model for a flat Earth cannot exist.

translation into english ongoing

(#183) Far side of the Moon (Moon's gravitational lock)

Whereas in the traditional model of the oblate Earth it is perfectly explained by gravitational locking (Tidal locking and the gravitational fold catastrophe, 2020), that is to say by the col point of the effective Earth-Moon potential:

$$U_{\text{eff}} = \frac{G^2 M_1^3 M_2^3}{L^2(M_1+M_2)}\left[\frac{1}{2\tilde{r}_2^2} - \frac{1}{\tilde{r}_2} - \frac{k_1\tilde{\omega}_2}{\tilde{r}_2^2} - \frac{k_2\tilde{\omega}_2}{\tilde{r}_2^2} + \frac{k_1\tilde{\omega}_1^2}{2} + \frac{k_2\tilde{\omega}_2^2}{2} + \frac{1}{2}\left(\frac{k_1\tilde{\omega}_1 + k_2\tilde{\omega}_2}{\tilde{r}_2}\right)^2\right]$$

Why the Moon always has the same face visible from Earth (taking libration into account):

Figure 105 Photo of the full moon taken on October 22, 2010 in Madison, Alabama (USA), using a Celestron 9.25 Schmidt-Cassegrain telescope. Photo taken with a Canon EOS Rebel T1i camera (EOS 500D), by stacking 20 shots (ISO 200 1/640 sec) to reduce noise (author: Gregory H. Revera, source: Wikipedia)

Flat Earth proponents cannot explain this factual observation with a mathematical model because in their hypothesis, the Sun and Moon are always above the flat Earth and revolve (according to them) around an imaginary barycenter which is located at the North Pole... or which revolves in a spiral (.....) and which obviously makes no sense to an intelligent person.

Figure 106 Sun-Moon motion according to the flat-Earth hypothesis (illustration credit: Mark Garlick/Science Photo Library via Getty)

translation into english ongoing

(#184) Orientation of the angles of the phases of the Moon

Because the Earth is an oblate sphere, it's very easy to explain why the angle of the Moon's phases varies with latitude. This is a phenomenon that anyone who has traveled even a little in their life has likely observed!

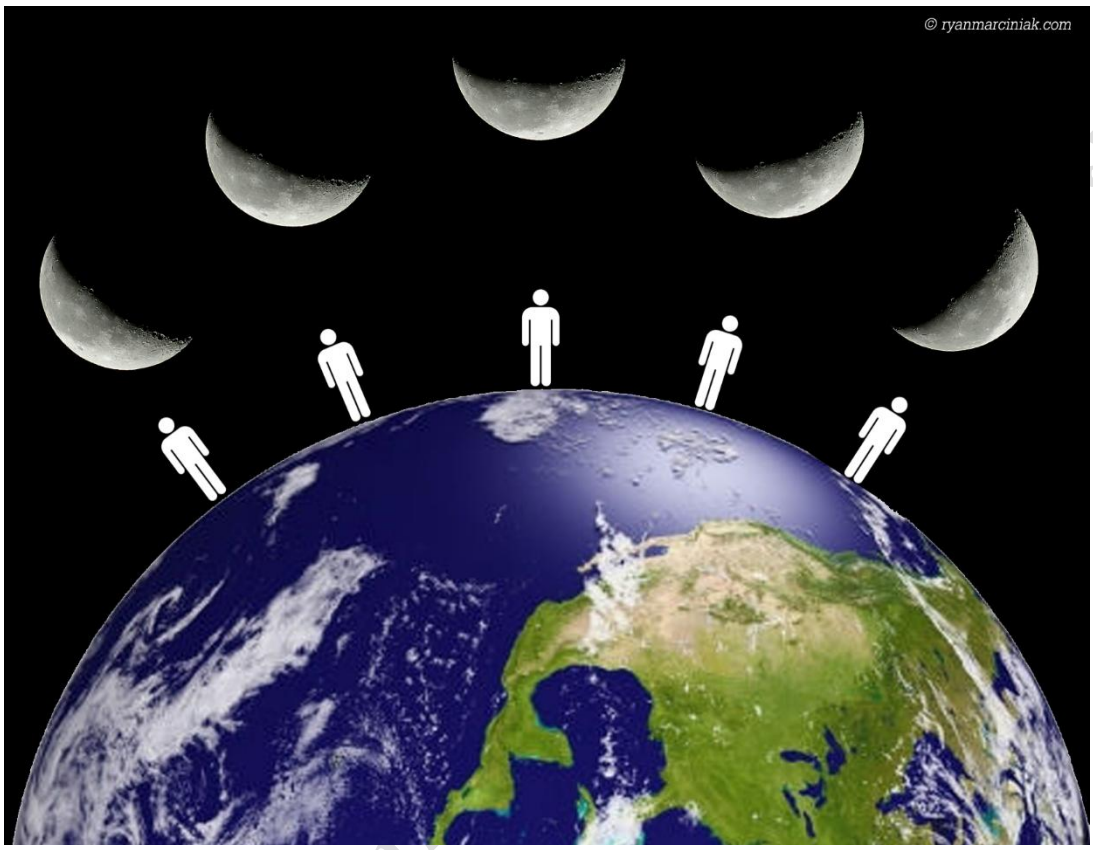
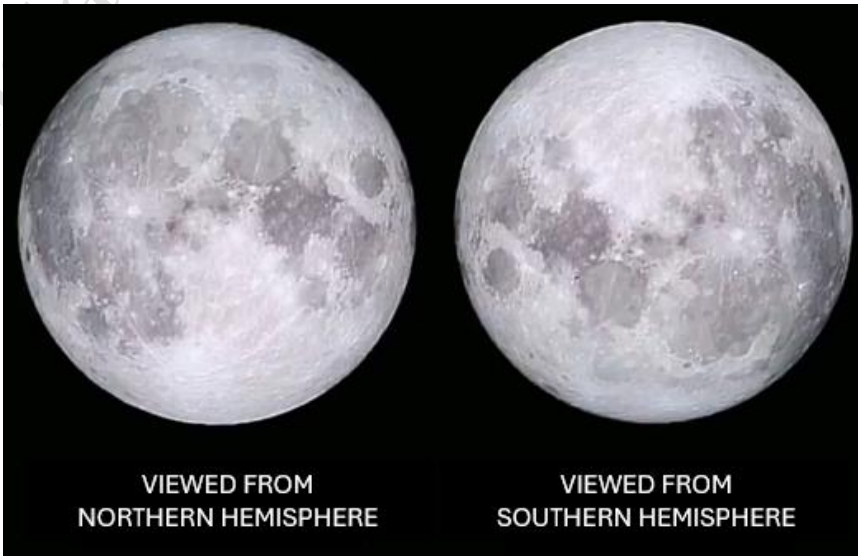
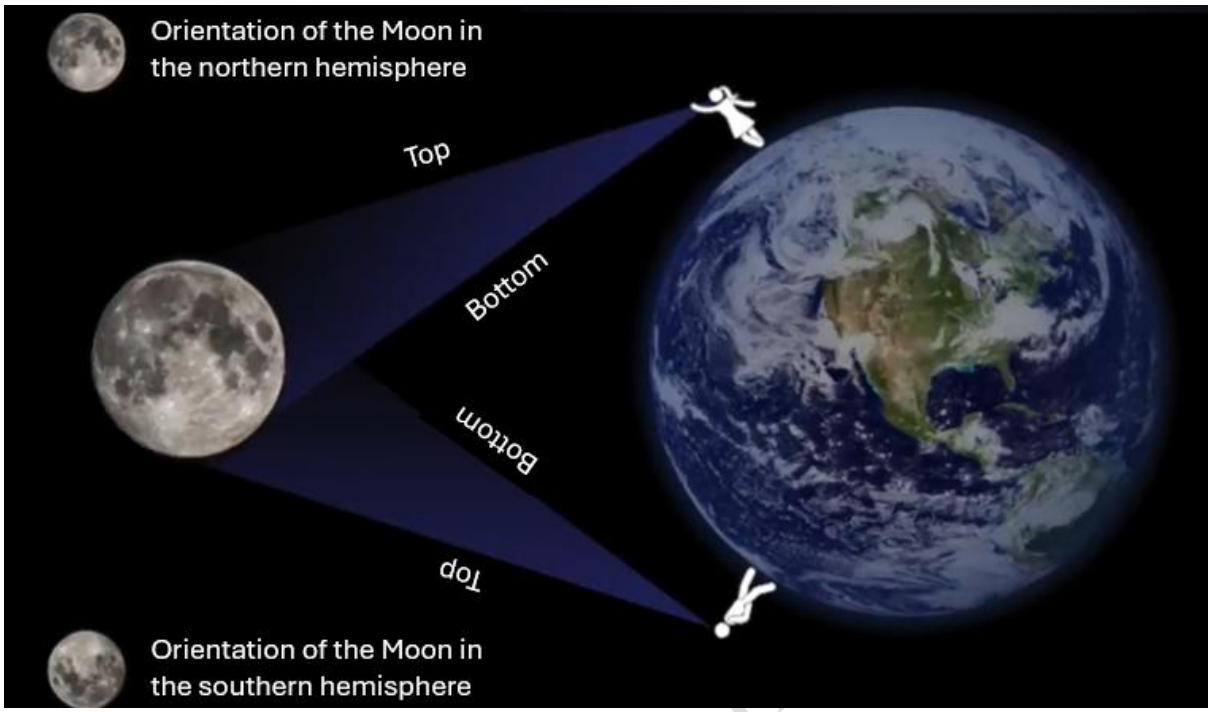


Figure 107 Artist's illustration of the phases of the Moon (copyright: Ryan Marciniak)

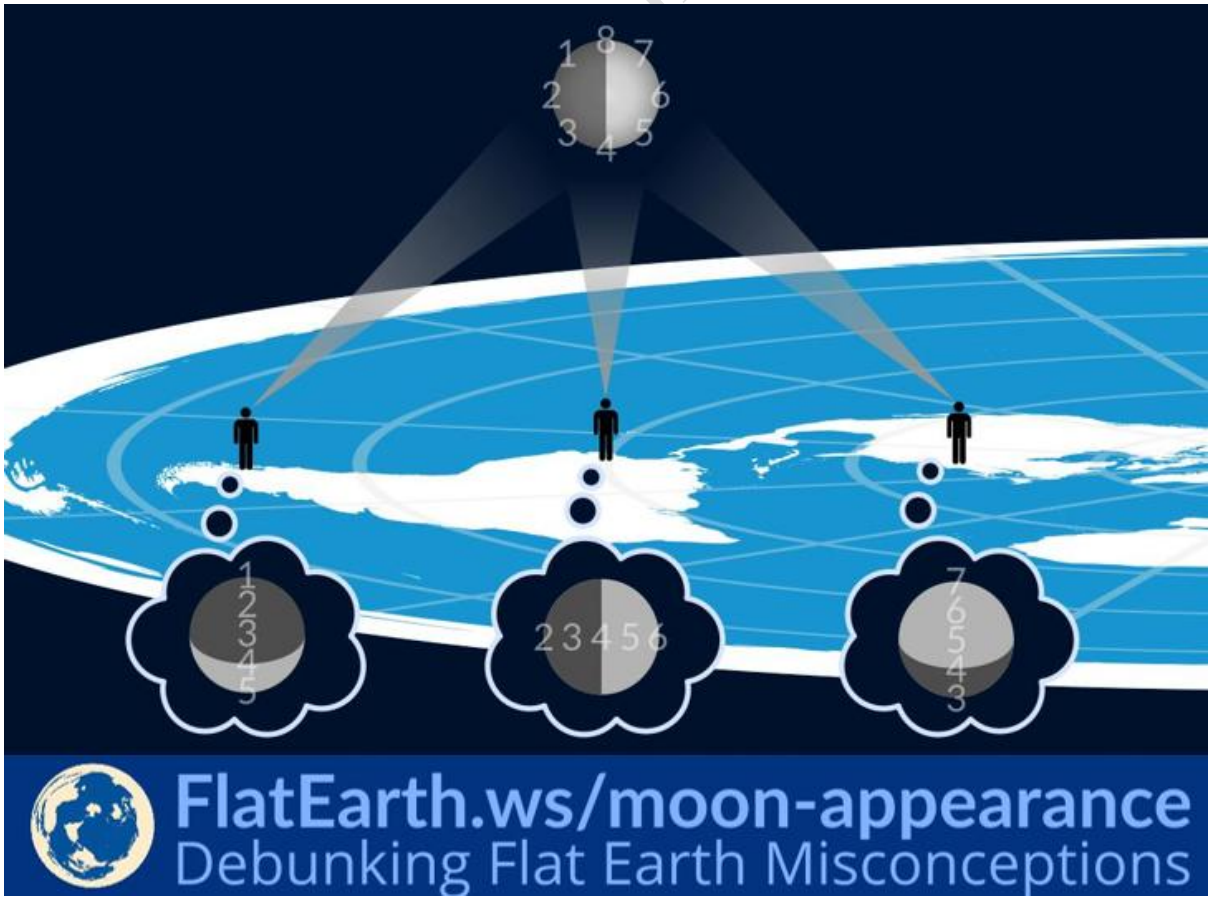
A simple way to verify that the flat Earth hypothesis doesn't work is to typically have three observers simultaneously observe the Moon at the same time zone during the night, while they are on the same meridian. The conclusion will then be irrefutable!



To put it simply:



Obviously, on a flat Earth this is problematic…:



Or, to better illustrate the absurdity of a flat Earth (with a possibly flat Moon as well…):

translation into english ongoing

(#185) 24-hours Moon in Antarctica

On a flat Earth, the movements of celestial bodies would not function in the same way as on a spherical Earth. Here are some reasons why a moon visible for 24 hours in Antarctica is impossible within a flat Earth model:

1. **Illumination angle:** On a spherical Earth, Antarctica benefits from continuous illumination during its summer months due to the tilt of the Earth's axis. On a flat Earth, it would be difficult to explain how the Moon could remain illuminated and visible for 24 hours in a specific region.

2. **Perspective and distance:** On a flat Earth, distant objects on the horizon would eventually disappear from view, as they would have to move far enough away to fall outside the field of vision. The Moon could not remain visible for 24 hours without disappearing below the horizon.

3. **Motion model:** The geocentric model of a spherical Earth implies that the Moon orbits the Earth in an elliptical path. On a flat Earth, the idea of a coherent and stable orbit or motion of the Moon becomes problematic.

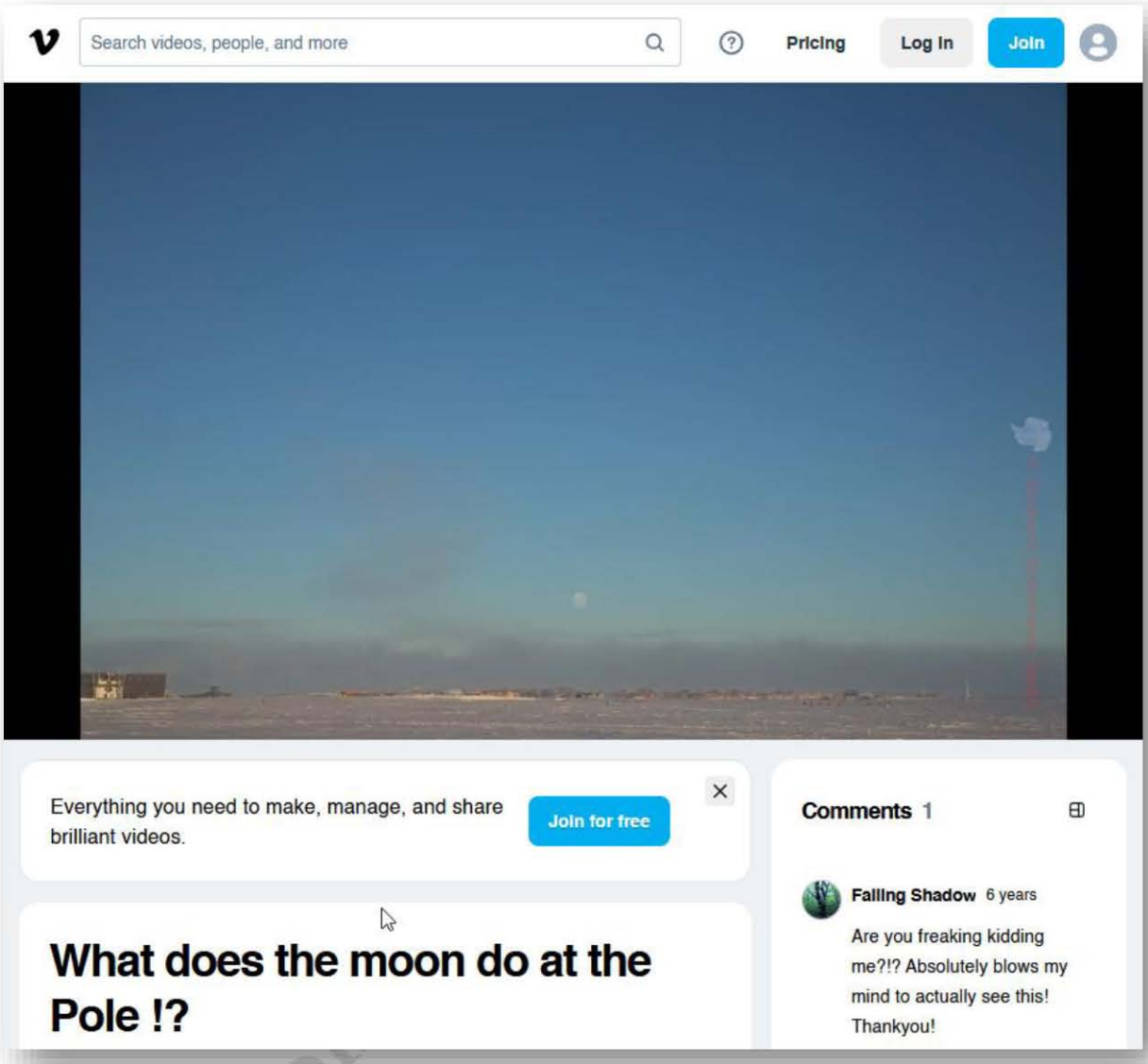
4. **Lunar phase cycles:** The phenomenon of lunar phases would also be difficult to explain on a flat Earth. The celestial mechanics of a spherical Earth, including the Moon's orbit around the Earth, offers a coherent explanation for the phases and eclipses.

In summary, the flat Earth hypothesis fails to account for observed phenomena related to the Moon and its phases, as well as the specific dynamics of celestial bodies in Antarctica.

So here's a link to a 24-hours timelapse video of the Moon in Antarctica, filmed in 2017 by Robert Schwarz, which once again debunks the flat Earth myth:

https://vimeo.com/237197696

translation into english ongoing

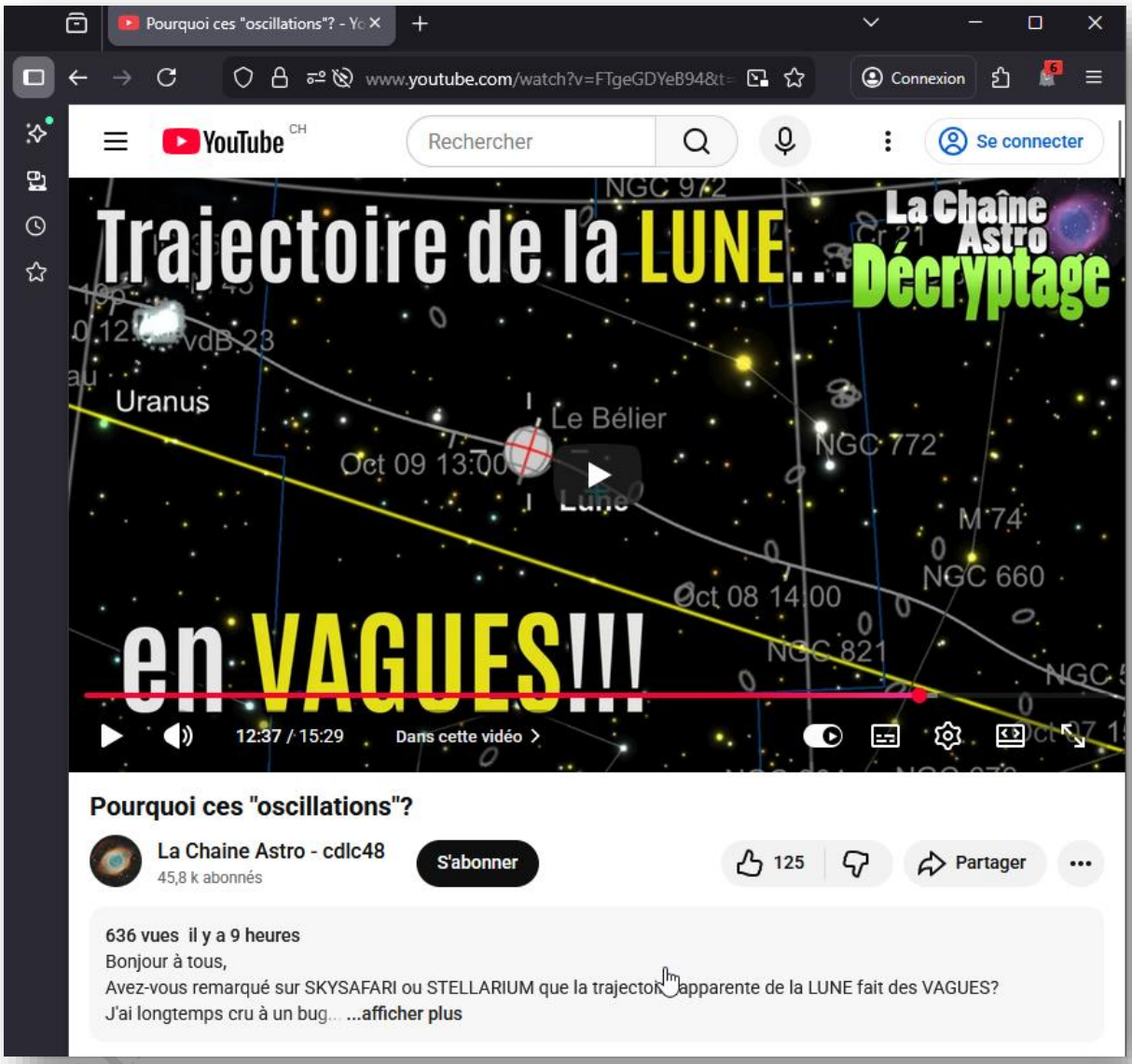

Search videos, people, and more
Pricing
Log In
Join
Everything you need to make, manage, and share brilliant videos.
Join for free
What does the moon do at the Pole !?
Comments 1
Falling Shadow 6 years
Are you freaking kidding me?!? Absolutely blows my mind to actually see this! Thankyou!

translation

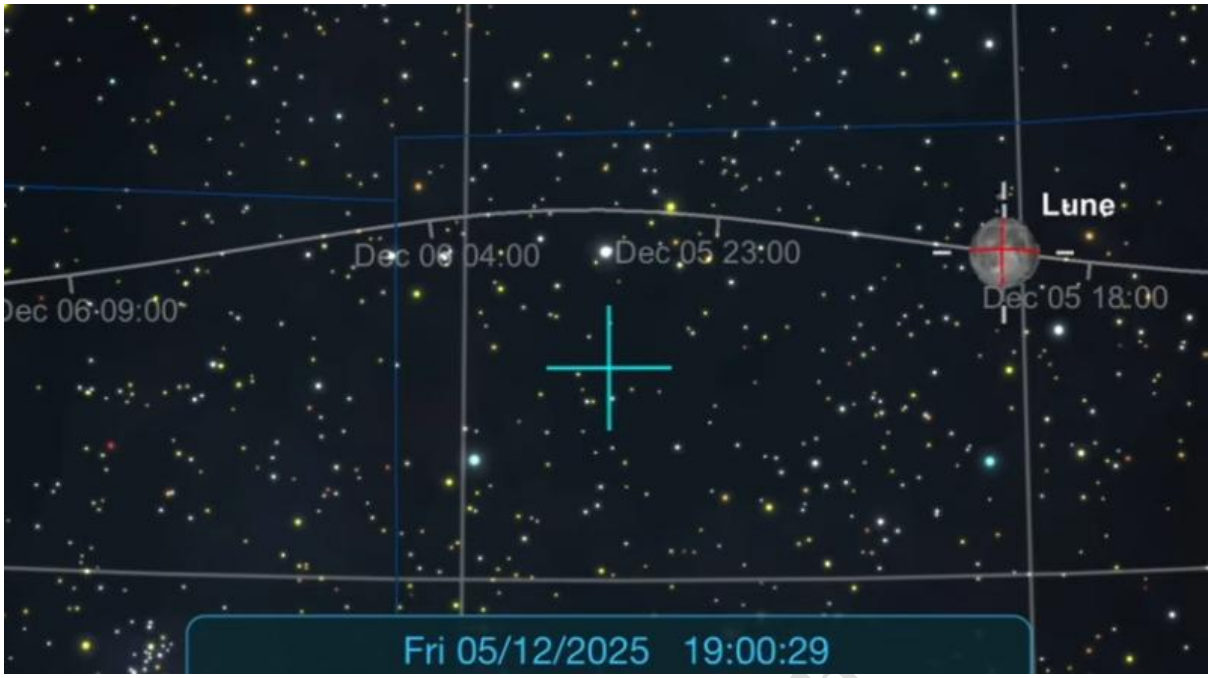
(#186) Moon's visual ondulated parallax and diurnal libration

The phenomenon is clearly explained in the video available here in french:

https://www.youtube.com/watch?v=FTgeGDYeB94&t=757s



In this video, the author explores a curious phenomenon observed on astronomy software such as Sky Safari or Stellarium: the Moon's trajectory does not appear to be a straight line or a regular curve, but rather traces sort of "waves" or S-shaped oscillations:



The goal is to demonstrate that what might look like a computer bug is actually a very real physical phenomenon, predictable and observable with amateur equipment.

The first key concept for explaining these ripples is the parallax effect. The author reminds us that our position on Earth influences how we perceive the Moon's position relative to distant stars. Depending on whether we are in northern or southern France, for example, the viewing angle changes slightly, which shifts the apparent position of the Moon. This same principle is used to accurately predict the visibility zones of planetary occultations.

The explanation for the ripples lies in the combined movement of the observer and the celestial body. During the summer solstice, as the night progresses, the Earth's rotation shifts the observer's "altitude" within the solar system's frame of reference (the plane of the ecliptic). Due to the parallax effect, this upward and then downward movement of the observer creates an apparent opposite movement of the Moon, giving it this shape of a descending then rising wave.

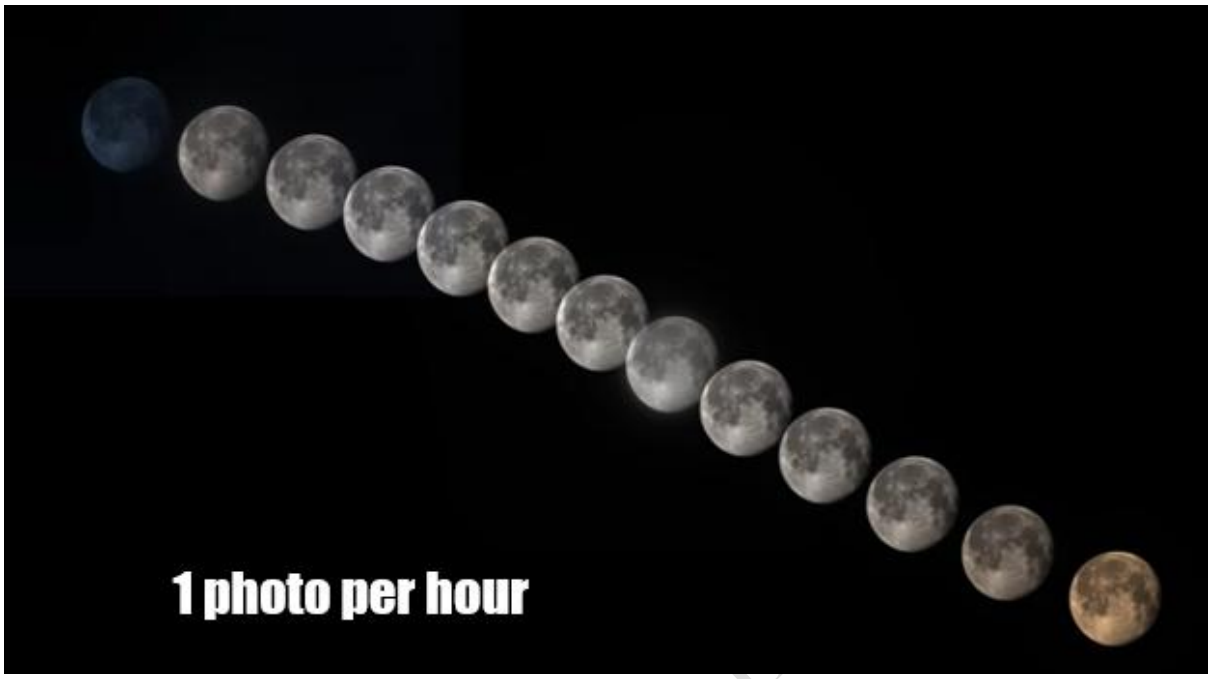
Conversely, during the winter solstice, the phenomenon occurs in the opposite way. The observer moves down and then up relative to the northern hemisphere of the solar system during the night. Consequently, the parallax gives the impression that the Moon rises and then sets in the sky. The author specifies that these variations are particularly noticeable during full moons at these times, as the duration of nighttime observation is at its maximum.

The apparent motion of the Moon is also influenced by its speed. The author explains that, in addition to vertical waves, a deceleration and acceleration effect is observed. Since the Earth rotates on its axis at a significant speed (approximately 1600 km/h at the equator), this speed is subtracted from or added to the Moon's orbital speed (approximately 3000 km/h). In the middle of the night, the observer moves in the same direction as the Moon, which creates the illusion that it is slowing down.

To prove these theories, the author conducted his own photographic experiment. Using an equatorial mount set to the sidereal (star-tracking) speed rather than the lunar speed, he allowed the Moon to cross the field of view of his sensor. By taking a photograph every five minutes

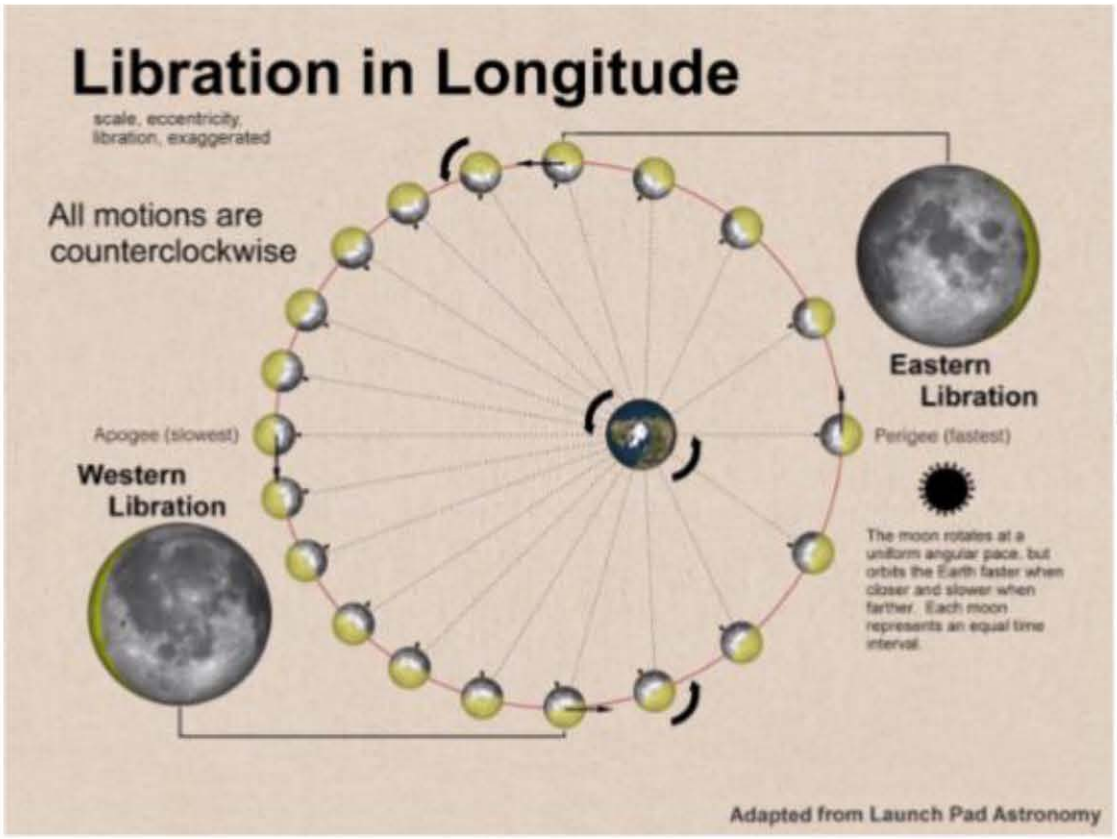
translation into english

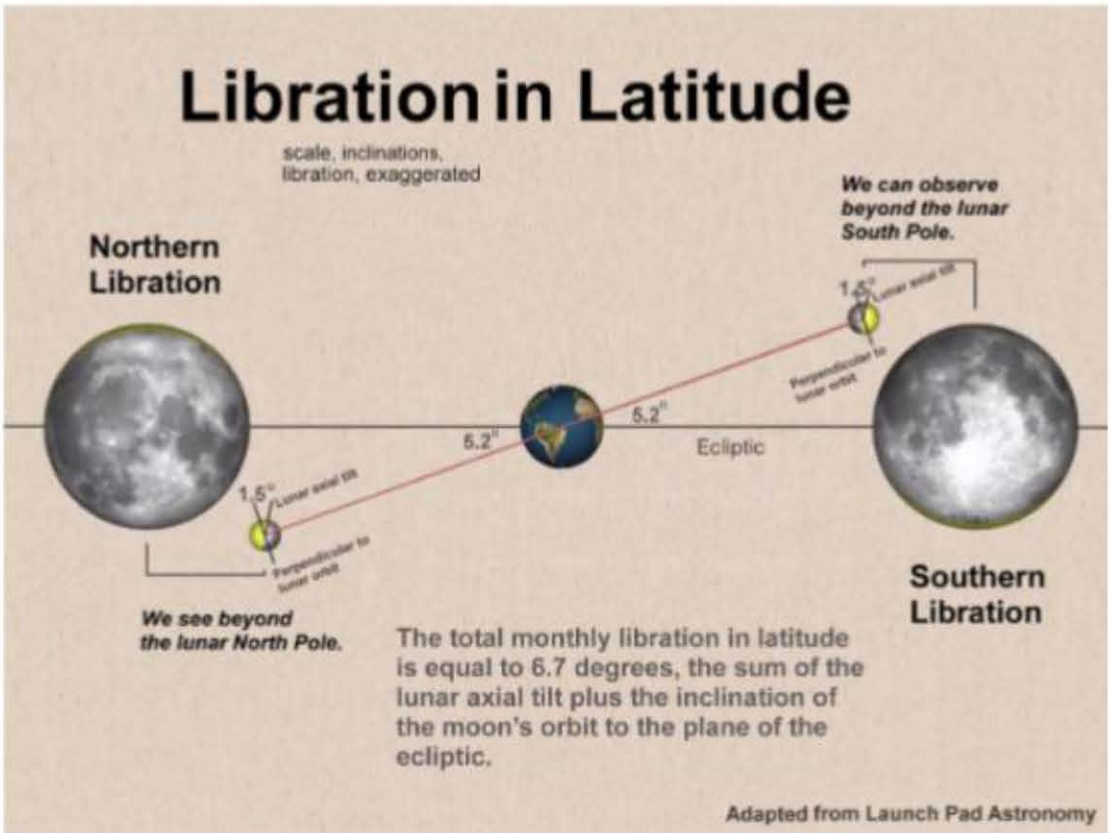
over an extended period, he was able to reconstruct the Moon's actual trajectory and visually confirm the presence of these oscillations and changes in speed.



The author also mentions another phenomenon related to parallax: the diurnal libration. Due to the observer's movement during the night, we don't see exactly the same portion of the Moon at sunrise and sunset. This slight change in angle allows us to see a little more "around" the lunar globe (left or right, north or south depending on the season), which complements the observation of the complex orbital motion.

Or explained with a schema:


Libration in Longitude
scale, eccentricity, libration, exaggerated
All motions are counterclockwise
Eastern Libration
Apogee (slowest)
Perigee (fastest)
Western Libration
The moon rotates at a uniform angular pace, but orbits the Earth faster when closer and slower when farther. Each moon represents an equal time interval.
Adapted from Launch Pad Astronomy


Libration in Latitude
scale, inclinations, libration, exaggerated
We can observe beyond the lunar South Pole.
Northern Libration
1.5°
Lunar axial tilt
Perpendicular to lunar orbit
5.2°
5.2°
Ecliptic
1.5°
Lunar axial tilt
Perpendicular to lunar orbit
We see beyond the lunar North Pole.
Southern Libration
The total monthly libration in latitude is equal to 6.7 degrees, the sum of the lunar axial tilt plus the inclination of the moon's orbit to the plane of the ecliptic.
Adapted from Launch Pad Astronomy

In conclusion, the video emphasizes that these "wave-like" trajectories are concrete evidence of the heliocentric model. They simultaneously demonstrate the Earth's rotation, its axial tilt,

its orbit around the Sun, and its sphericity. Far from being a software bug, these undulations are the visual signature of our own movement through space, confirmed by mathematical models and direct observation.

None of this has ever been explained or modeled by flat Earth proponents, and we know very well why…

translation into english ongoing

Solar Eclipses

We have already addressed this case at the page 309. But as a reminder:

Solar eclipses are incompatible with the flat Earth model for several reasons:

1. **Celestial body alignment:** A solar eclipse occurs when the Moon passes between the Earth and the Sun, casting its shadow on the Earth. In a flat Earth model, it would be difficult to explain how the Moon could consistently and regularly block sunlight, as the trajectories and distances between these celestial bodies would not be the same.
2. **Moon's Shadow:** During a solar eclipse, the Moon's shadow falls on a narrow band of the Earth's surface. This band, called the "path of totality," is due to the Earth's spherical shape and the way light travels. On a flat Earth, the shape and movement of this shadow would be very different and would not correspond to actual observations.
3. **Frequency and predictability:** Solar eclipses are predictable phenomena thanks to our understanding of the Earth's and Moon's orbits. Models based on a spherical Earth can accurately predict the dates and locations of eclipses at the second and at the meter level (what Saros cycles cannot!). A flat Earth model could not provide such precise and consistent predictions.
4. **Global observation:** Solar eclipses are only visible from certain parts of the Earth at any given time. This is due to the Earth's curvature and the relative position of observers with respect to the Moon's shadow. On a flat Earth, eclipses would be visible in a very different way, perhaps impossible to explain coherently.

These points show that solar eclipses, as observed and understood, are consistent with a spherical Earth model and pose insurmountable challenges for a flat Earth hypothesis!

Modern solar eclipse predictions do not use Saros cycles because they are too imprecise, but rather the Bessel method based on the WRF-ARD model (Implementation of Bessel's method for solar eclipses prediction in the WRF-ARW model, 2016) :

translation into english ongoing

Appendix A

Physically, a solar eclipse occurs when the lunar and solar centers are distant from one another by an arc in the celestial sphere equal to the sum of their radii (Buchanan, 1904). For many centuries, earlier astronomers tried to determine the occurrence of a solar eclipse based on the movement of both celestial bodies in the sky. Although they made high-accuracy predictions, the method was not efficient because of the laborious computations being only valid for a given place. In the 18th century, after Kepler's laws and the *Principia* of Sir Isaac Newton, astronomers such as Edmund Halley made different eclipse predictions based on the Earth and Moon orbits, but the mathematical treatment was highly complex due to the Earth and Moon's respective movements (i.e., translation, rotation, nutation) around the Sun.

At the beginning of the 19th century, Friedrich Wilhelm Bessel developed a new method providing a high-level mathematical simplification independent of the observer. In fact, the approach is more general and it is valid for predicting the place and time for observing all celestial phenomena as occultations and eclipses. This method is still being used in the computer algorithms used for solar eclipse predictions (e.g., NASA).

The method was widely detailed in books and manuals such as Chauvenet (1871). However, we include a brief description of Bessel's method in this appendix in order to contextualize the implementation within the WRF-ARW model described in Sect. 2.

The main idea of this approach is to reduce the problem to a single plane which passes through the Earth's center and which is perpendicular to the axis of the Moon's shadow. This plane is named fundamental plane.

Before following with the description, let us define a Cartesian coordinate system in $\mathbb{R}^3$ in which the X and Y axes are constructed on the fundamental plane, with the origin at the Earth's center. In this new reference system, let us assume that the positive X axis runs in the eastern direction and the Y axis runs in the northern direction. By construction, the Z axis is normal to the fundamental plane and parallel to the axis of the shadow. This new system is more useful than the one located at the Earth's surface because we can define a set of magnitudes relative to the fundamental plane that are independent of the observer.

These variables are the coordinates x and y of the point where the shadow axis crosses the fundamental plane, the direction of the shadow axis in the celestial sphere described by the declination d and the ephemeride solar angle μ, the radii of the penumbral and umbral shadows l_1 and l_2 in the fundamental plane, and the angle that the penumbral α_1 and umbral α_2 shadow cones make with the shadow axis defined by $f_1 = \tan\alpha_1$ and $f_2 = \tan\alpha_2$. This set of variables is named Besselian elements, and they only depend on time in the XYZ system. Therefore, the Besselian elements can be computed before an eclipse and used to determine the episode features as the trajectory of the shadow or the visibility in any place around the Earth.

For the particular case of the solar eclipses, NASA supplies two catalogs: the *Five Millennium Catalog of Solar Eclipses* (Espenak and Meeus, 2008) that contains all episodes since 2000 BCE to 3000 CE and the Ten Millennium Catalog of Long Solar Eclipses (Espenak and Meeus, 2009) with a period from 4000 BCE to 6000 CE.

In these catalogs, NASA provides for each eclipse a reference time t_0 in the Terrestrial Dynamical Time (TDT) reference system and a set of polynomial coefficients to compute the Besselian elements valid in a 6 h period centered on t_0 (i.e., $t_0 \pm 3$).

For a given eclipse and time t_1 in TDT, the Besselian elements are evaluated as

$$x = x_0 + x_1 t + x_2 t^2 + x_3 t^3, \quad \text{(A1)}$$

$$y = y_0 + y_1 t + y_2 t^2 + y_3 t^3, \quad \text{(A2)}$$

$$d = d_0 + d_1 t + d_2 t^2, \quad \text{(A3)}$$

$$\mu = \mu_0 + \mu_1 t + \mu_2 t^2, \quad \text{(A4)}$$

$$l_i = l_{i,0} + l_{i,1} t + l_{i,2} t^2, \quad \text{(A5)}$$

with $i = 1, 2$ (penumbra and umbra) and where $t = t_1 - t_0$ in TDT. Note that the cone angles f_1 and f_2 are assumed to be constant during all the eclipse (i.e., $t_0 \pm 3$ h). By construction, the penumbra shadow radius in the fundamental plane l_1 is always defined as a positive value, while the umbra shadow radius l_2 is defined as positive for annularity and negative for totality.

Internally, the WRF-ARW model considers the time in the Coordinated Universal Time (UTC) system. Therefore, before computing the Besselian elements, this time should be converted to TDT. This conversion is performed using a variable that astronomers call "delta-T" or, hereinafter, Δt. Conceptually, this parameter is a correction to time due to the differences in the Earth rotation produced by the angular momentum transferred from Earth to the Moon by the tidal friction. This variable is also provided in the catalogs for eclipses.

Thus, t is computed as

$$t = t_1^{\mathrm{TDT}} - t_0^{\mathrm{TDT}} = (t_1^{\mathrm{UTC}} - \Delta t) - t_0^{\mathrm{TDT}}. \quad \text{(A6)}$$

The key point in order to implement the eclipses in an NWP model is the determination of the degree of obscuration D of the solar disk at each grid point of the domain (Sect. 2). Each grid point is characterized by two geographical coordinates given by the latitude ϕ and longitude λ. Therefore, first of all, we need to transform this pair of coordinates into the reference system XYZ.

Nevertheless, we need to introduce a couple of corrections to the geographical coordinates provided by the atmospheric

The detailed modern mathematical developments for predicting solar eclipses are available on pages 486 to 542 in (A Manual of Spherical and Practical Astronomy: Spherical astronomy, 1874). The reader can verify in the latter reference there that the Earth is considered spherical and the heliocentric model is used for the simple reason that a detailed and robust model for a flat Earth cannot exist.

Tides

The hypothesis of proponents of the flat Earth requires several strong constraints which once again pose problems that are insoluble in the reality of the physical world that can be measured and tested experimentally.

Let's look at a few of them:

(#187) Flat-Earth hypothesis without Gravity

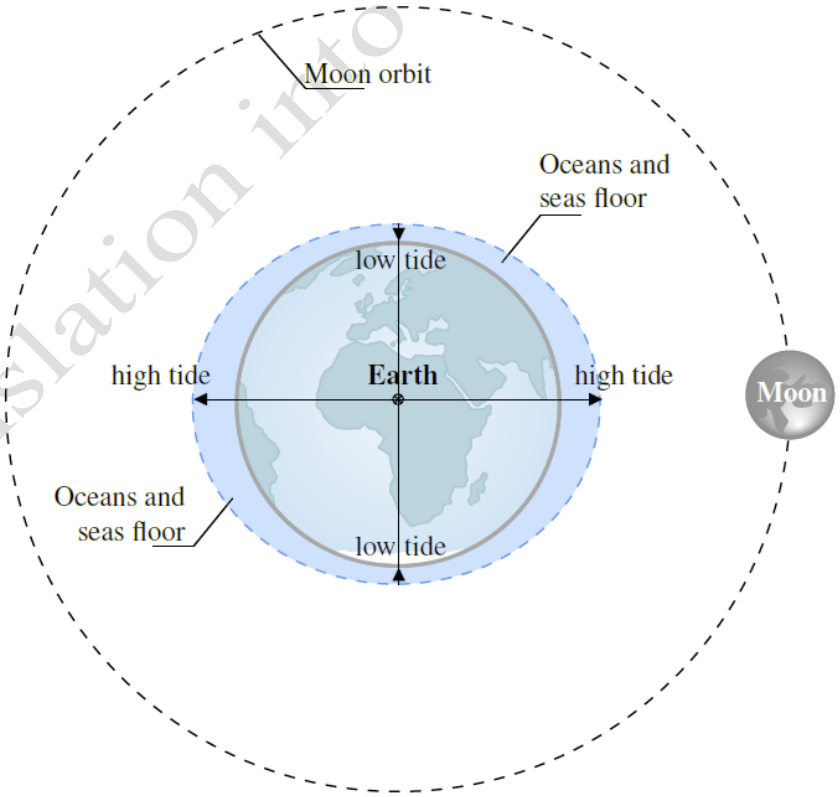
In the hypothesis of the proponents of the flat Earth, Newton's gravity as well as General Relativity (from which Newton's gravity derives in the weak field approximation for reminder) do not exist otherwise the flat Earth would be uninhabitable in several aspects.

Flat Earth proponents therefore reject gravity and perform nonsensical acrobatics to substitute gravity with Archimedes' principle (LoL...).

In their hypothesis, since gravity doesn't exist, there can't be tides on the flat Earth…

Whereas for the globe, we have the following naive mathematical model (but there are much more complex ones!) which accounts relatively well for the observed tides (Opera Magistris, 2024):

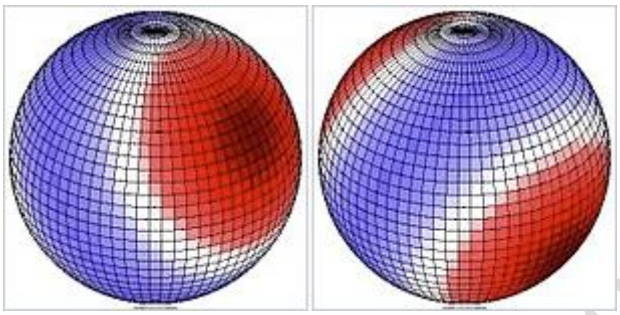
$$f = GmM_L \frac{r}{R^3}$$



translation into english ongoing

In 1776, Laplace formulated a unique set of linear partial differential equations for tidal flow, described as a two-dimensional barotropic sheet flow. Coriolis effects and lateral forcing by gravity are introduced. Laplace obtained these equations by simplifying the equations of fluid dynamics, but they can also be derived from energy integrals via Lagrange's equation.

For a fluid sheet of average thickness D, the vertical tidal rise ζ, as well as the horizontal velocity components u and v (in the directions of latitude φ and longitude λ, respectively) satisfy Laplace's tidal equations:



$$\frac{\partial \xi}{\partial t} + \frac{1}{a\cos(\varphi)}\left[\frac{\partial}{\partial \lambda}(uD) + \frac{\partial}{\partial \varphi}\left(vD\cos(\varphi)\right)\right] = 0$$

$$\frac{\partial u}{\partial t} - v2\Omega\sin(\varphi) + \frac{1}{a\cos(\varphi)}\frac{\partial}{\partial \lambda}(g\lambda + U) = 0$$

$$\frac{\partial v}{\partial t} - u2\Omega\sin(\varphi) + \frac{1}{a}\frac{\partial}{\partial \lambda}(g\lambda + U) = 0$$

where Ω is the angular frequency of the planet's rotation, g is the gravitational acceleration of the planet at the mean ocean surface, a is the planetary radius and U is the external gravitational tidal force potential.

A private company uses a mathematical model (FEM: Finite Elements Methods) of tides based on the fact that the Earth is a globe, the topography of the seabed, the topology of the coasts, and other parameters:

https://www.predictwind.com/predictcurrent

Using the finite element method (Opera Magistris, 2024) several algorithms running on grid-computers can predict multiple tides or the absence of tides depending on the regions and multiple factors as stated and described in (Tidal prediction using the advanced circulation model (ADCIRC) and a relocatable PC-based system, 2002).

Or here is a more elaborate formal model by Whitaker in 1968 (Ocean tides, part I: global ocean tidal equations, 1980) :

translation into english ongoing

bulent motions of a viscous, incompressible fluid including all unknown Reynolds stresses (see, e.g., Schlichting, 1968), which must provide the major friction stress to keep the intrinsic supercritical instability of the flow under control. In rotating spherical polar coordinates (λ, ϕ, r), these equations may be written in the form (see, e.g., Whitaker, 1968):

$$u_t + \frac{u}{r\cos\phi}u_\lambda + \frac{v}{r}u_\phi + wu_r - \frac{uv}{r} - \frac{uv}{r}\tan\phi + \frac{uw}{r} = \frac{1}{r\cos\phi}\left(q - \frac{p}{\rho}\right)_\lambda + 2\Omega(v\sin\phi - w\cos\phi) + f^\lambda, \tag{1a}$$

$$v_t = \frac{u}{r\cos\phi}v_\lambda + \frac{v}{r}v_\phi + wv_r + \frac{u^2}{r}\tan\phi + \frac{vw}{r} = \frac{1}{r}\left(q - \frac{p}{\rho}\right)_\phi - 2\Omega u\sin\phi - \frac{1}{2}\Omega^2 r\sin 2\phi + f^\phi, \tag{1b}$$

$$w_t + \frac{u}{r\cos\phi}w_\lambda + \frac{v}{r}w_\phi + ww_r - \frac{1}{r}(u^2 + v^2) = -\left(G + \frac{1}{\rho}p_r\right) + 2\Omega u\cos\phi + \Omega^2 r\cos^2\phi + f^r, \tag{1c}$$

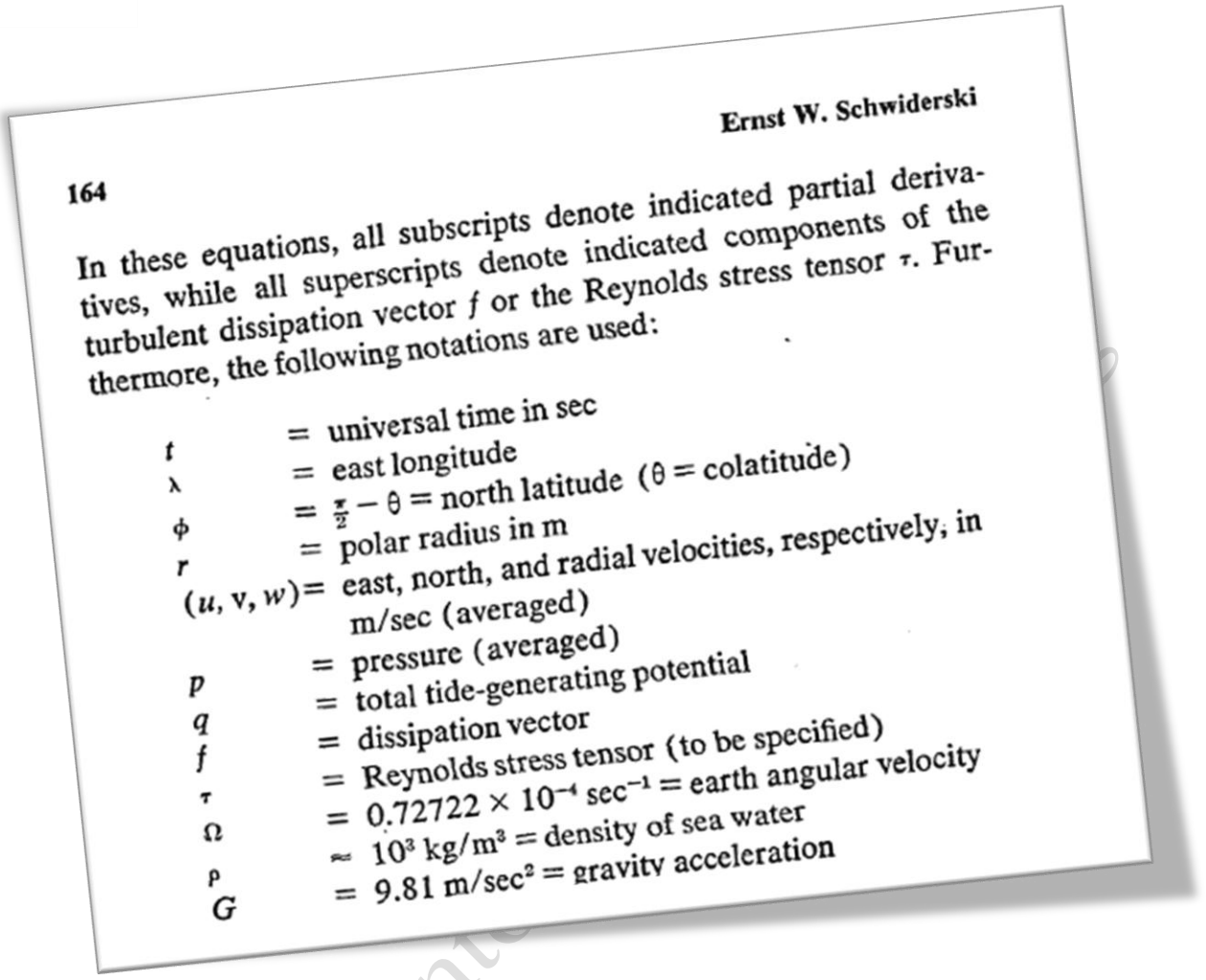
$$\frac{1}{r\cos\phi}\left[u_\lambda + (v\cos\phi)_\phi\right] + \frac{1}{r^2}(r^2 w)_r = 0, \tag{2}$$

$$\rho f^\lambda = \frac{1}{r\cos\phi}\tau_\lambda^{\lambda\lambda} + \frac{1}{r}\tau_\phi^{\lambda\phi} + \tau_r^{\lambda r} + \frac{3}{r}\tau^{\lambda r} - \frac{2}{r}\tau^{\lambda\phi}\tan\phi, \tag{3a}$$

$$\rho f^\phi = \frac{1}{r\cos\phi}\left[\tau_\lambda^{\lambda\phi} + (\tau^{\phi\phi}\cos\phi)_\phi\right] + \tau_r^{\phi r} + \frac{3}{r}\tau^{\phi r} + \frac{1}{r}\tau^{\lambda\lambda}\tan\phi, \tag{3b}$$

$$\rho f^r = \frac{1}{r\cos\phi}\left[\tau_\lambda^{\lambda r} + (\tau^{\phi r}\cos\phi)_\phi\right] + \tau_r^{rr} + \frac{1}{r}(2\tau^{rr} - \tau^{\phi\phi} - \tau^{\lambda\lambda}). \tag{3c}$$

With :



Ernst W. Schwiderski

164

In these equations, all subscripts denote indicated partial derivatives, while all superscripts denote indicated components of the turbulent dissipation vector f or the Reynolds stress tensor τ. Furthermore, the following notations are used:

t = universal time in sec
λ = east longitude
$\phi = \frac{\pi}{2} - \theta$ = north latitude (θ = colatitude)
r = polar radius in m
(u, v, w) = east, north, and radial velocities, respectively, in m/sec (averaged)
p = pressure (averaged)
q = total tide-generating potential
f = dissipation vector
τ = Reynolds stress tensor (to be specified)
Ω = 0.72722×10^{-4} sec^{-1} = earth angular velocity
ρ = 10^3 kg/m^3 = density of sea water
G = 9.81 m/sec^2 = gravity acceleration

With supercomputers, it is even possible to model internal tides (Modeling and predicting tides over the World Ocean, 1995)!

translation int

(#188) Number of tides per day

In the simplified high school model for tides or the more complex Lagrange model, there are two tides per day. Obviously, flat-Earthers can't even explain a single tide per day since, for them, gravity doesn't exist (otherwise, a flat Earth would be a physical impossibility if gravity existed).

In reality, neither the naive high school model nor the more complex Lagrange model takes into account ocean currents and gravitational anomalies. For that, numerical models and supercomputers are needed, capable of predicting tides everywhere around the globe with very high accuracy. In contrast, proponents of the flat Earth theory cannot predict anything at all because their margin of error is enormous.

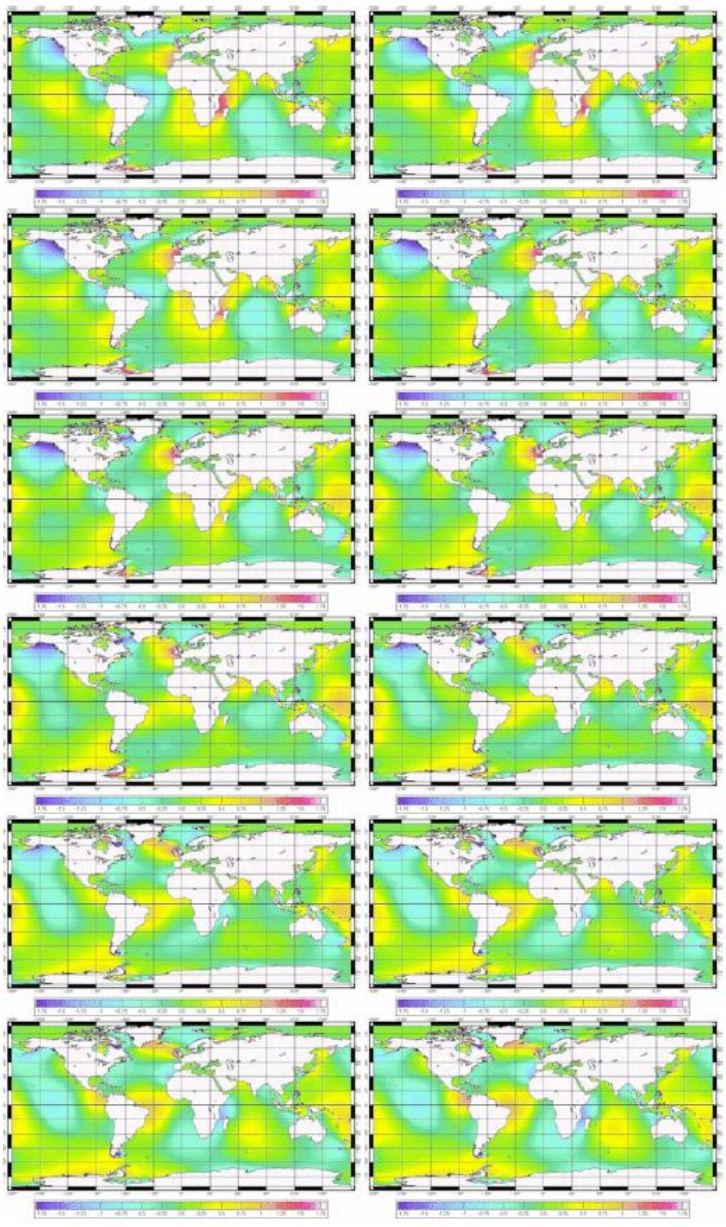
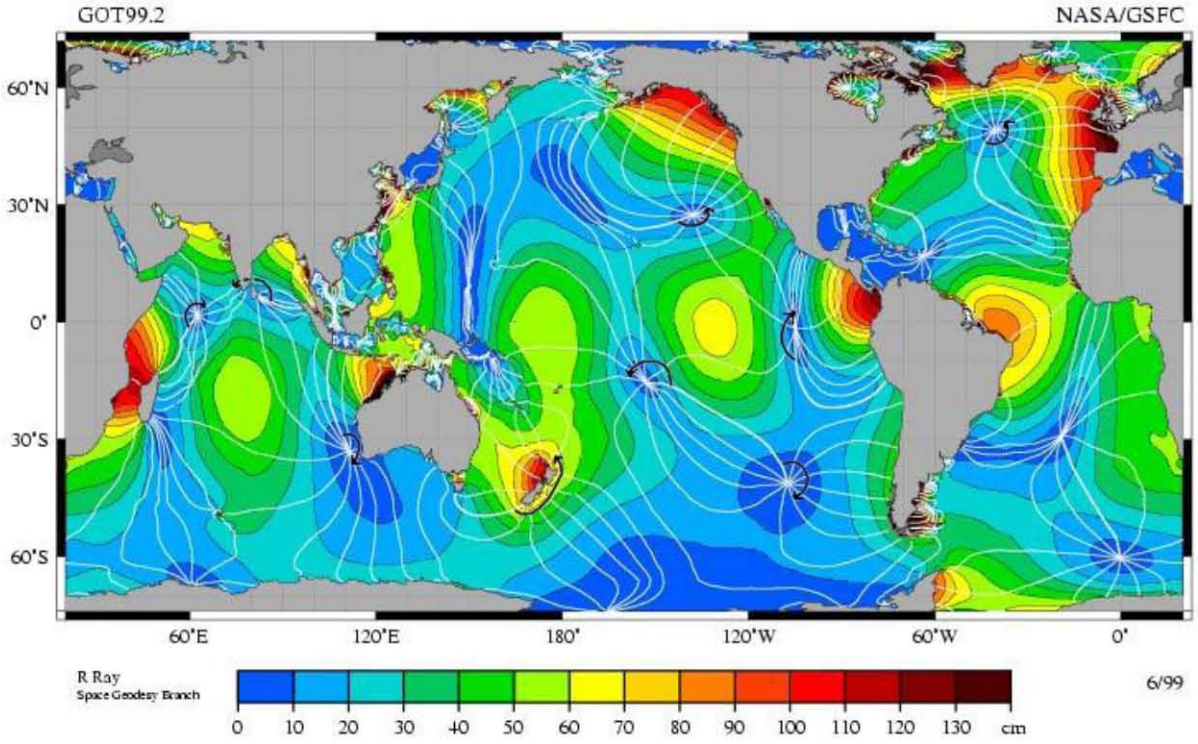


Figure 108 Sequence of the actual dynamics of tides

The reader can verify that Ko Chang Tai in Thailand sometimes only has one tide per day. To summarize:



translation into e

Astronomical Observations and Navigation

Numerous astronomical observations and navigational instruments also linked to astronomy pose insurmountable problems for flat Earth proponents, who are unable to explain their existence nor how they work in detail without resorting to rhetoric and burying the issue under a layer of arguments that makes no sense!

(#189) Astrolabe

Proponents of the flat Earth hypothesis claim that astrolabes can only work because the Earth is flat. They are wrong. Astrolabes were designed based on the spherical Earth model by Greek scholars who already knew, at least by the 5th century BCE, that the Earth was a globe. The astrolabe was probably invented in ancient Greece around 225 BCE and was based on the research of Hipparchus.

Figure 109 14th century astrolabe, Spain (source: Aga Khan Museum)

To use an astrolabe, a good understanding of the spherical Earth model is necessary. The star chart portion of an astrolabe consists of two parts: the material, which represents the view of the sky from the observer's perspective, and the star, which represents the celestial sphere. The star is a basic star chart, centered on the north celestial pole, representing the celestial sphere generally as far south as the Tropic of Capricorn. To use an astrolabe south of the equator, a specific south star is required. The stars are arranged using stereographic projection, which preserves the shape of the constellations but distorts their sizes. Constellations closer to the edge appear comparatively larger than those near the celestial pole.

The material represents the sky as seen by the observer. It marks the boundary within which the stars depicted are visible. Since the Earth is spherical, there are specific plates for each specific observer's latitude:

Figure 110 AKM611, Astrolabe with different plates (source: Aga Khan Museum)

Since most astrolabes describe the celestial sphere as far as the far tropical parallel, the material cannot show the observer's complete view unless they are north of the Arctic Circle (or south of the Antarctic Circle for southern astrolabes). In the flat-Earth scenario, the star is analogous to the equidistant azimuthal map, which flat-Earth proponents mistakenly refer to as "the flat-Earth map." The material is analogous to the day/night boundary in the equidistant azimuthal map. In both cases, objects closer to the edge are more distorted. But in the case of astrolabes, the distortion can be easily seen and confirmed simply by looking at the sky. In a northern astrolabe, constellations to the north appear smaller than those to the south.

Astrolabes are designed with the Earth as a sphere in mind, and they would be unusable if the Earth were flat. A good understanding of the Earth as a sphere is necessary to use an astrolabe.

translation into en ng

(#190) Sextant

A sextant is a navigational instrument that measures the angle between a celestial object (such as the Sun or a star) and the horizon. The sextant was invented in the 1730s by two people independently of each other: John Hadley, a British mathematician and astronomer, and Thomas Godfrey, an American inventor.

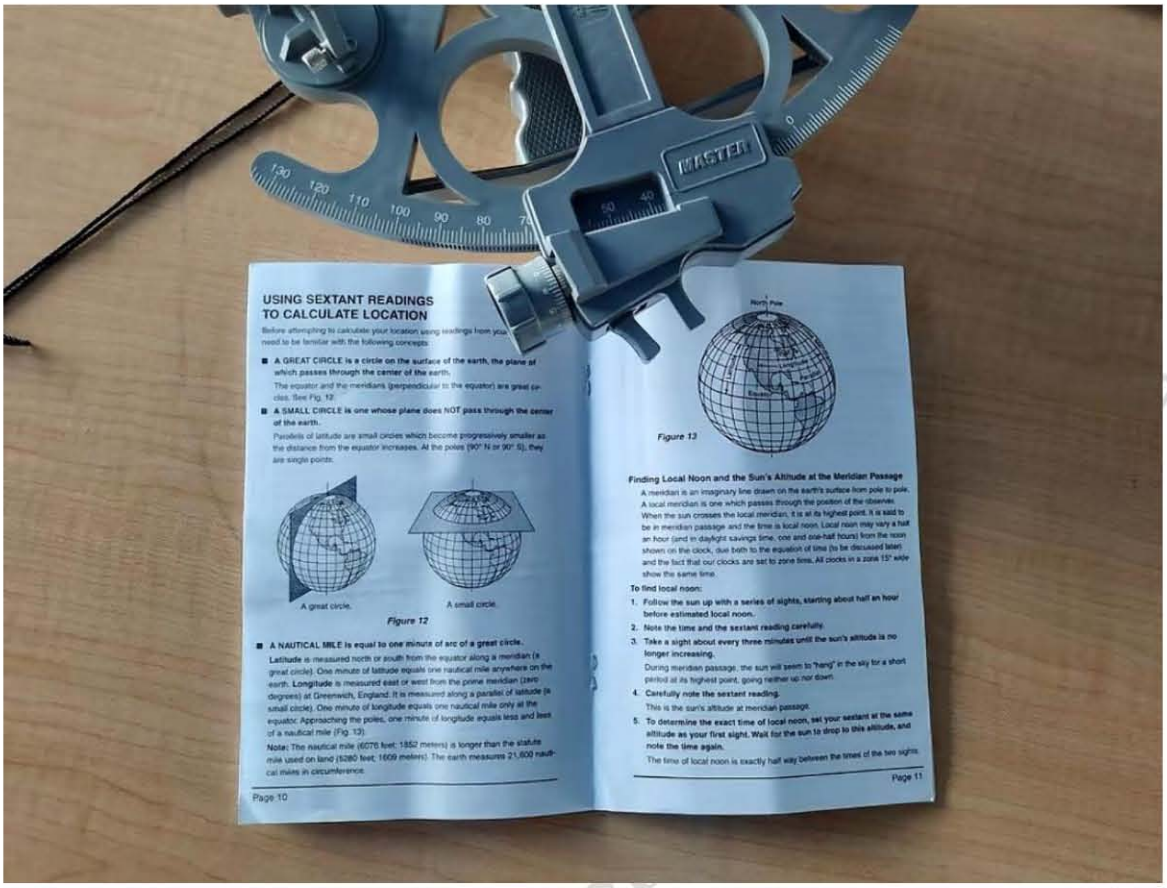
Here's why the sextant proves that the Earth is a sphere:

- **Angles measurement:** The sextant allows for the precise measurement of angles between the horizon and celestial objects. On a flat Earth, the measured angles would not correspond to calculations based on a sphere.
- **Calculating latitude:** Using a sextant, navigators can determine their latitude by measuring the angle of the Sun at noon. These calculations are based on the curvature of the Earth and the relative position of celestial objects.
- **Distance and curvature:** Measurements taken with a sextant show that the distance between two points on the Earth's surface varies depending on the Earth's curvature. This confirms that the Earth is not flat.
- **Historical note:** Sailors and explorers have used sextants for centuries to navigate accurately over long distances. Their success was based on the understanding that the Earth is a sphere.

These points show that the use and measurements taken with a sextant are based on the model of a spherical Earth, thus confirming its shape.

Here is a photo of a sextant with its instruction manual:

translate to english ongoing


MASTER
130
120
110
100
90
80
USING SEXTANT READINGS
TO CALCULATE LOCATION
Before attempting to calculate your location using readings from your
need to be familiar with the following concepts:
A GREAT CIRCLE is a circle on the surface of the earth, the plane of which passes through the center of the earth.
The equator and the meridians (perpendicular to the equator) are great circles. See Fig. 12.
A SMALL CIRCLE is one whose plane does NOT pass through the center of the earth.
Parallels of latitude are small circles which become progressively smaller as the distance from the equator increases. At the poles (90° N or 90° S), they are single points.
A great circle.
A small circle.
Figure 12
A NAUTICAL MILE is equal to one minute of arc of a great circle.
Latitude is measured north or south from the equator along a meridian (a great circle). One minute of latitude equals one nautical mile anywhere on the earth. Longitude is measured east or west from the prime meridian (zero degrees) at Greenwich, England. It is measured along a parallel of latitude (a small circle). One minute of longitude equals one nautical mile only at the equator. Approaching the poles, one minute of longitude equals less and less of a nautical mile (Fig. 13).
Note: The nautical mile (6076 feet; 1852 meters) is longer than the statute mile used on land (5280 feet; 1609 meters). The earth measures 21,600 nautical miles in circumference.
Page 10
North Pole
Figure 13
Finding Local Noon and the Sun's Altitude at the Meridian Passage
A meridian is an imaginary line drawn on the earth's surface from pole to pole. A local meridian is one which passes through the position of the observer. When the sun crosses the local meridian, it is at its highest point. It is said to be in meridian passage and the time is local noon. Local noon may vary a half an hour (and in daylight savings time, one and one-half hours) from the noon shown on the clock, due both to the equation of time (to be discussed later) and the fact that our clocks are set to zone time. All clocks in a zone 15° wide show the same time.
To find local noon:
1. Follow the sun up with a series of sights, starting about half an hour before estimated local noon.
2. Note the time and the sextant reading carefully.
3. Take a sight about every three minutes until the sun's altitude is no longer increasing.
During meridian passage, the sun will seem to "hang" in the sky for a short period at its highest point, going neither up nor down.
4. Carefully note the sextant reading.
This is the sun's altitude at meridian passage.
5. To determine the exact time of local noon, set your sextant at the same altitude as your first sight. Wait for the sun to drop to this altitude, and note the time again.
The time of local noon is exactly half way between the times of the two sights.
Page 11

translation into e

(#191) Calf's head (navisphere)

In maritime navigation, a “calf's head” is a navigational instrument used to measure angles. It is also known as a “Navisphere”. This term comes from the instrument's smooth, often white surface, which can be somewhat reminiscent of a calf's head.

Figure 111 Navisphere (photos : Yann Lods, Objets de Marine, www.la-palmeraie.com)

This device is used to determine a ship's position by measuring the angular altitudes of celestial bodies. It was an essential tool for navigation before the advent of satellite navigation systems.

Obviously, this instrument only makes sense on a spherical Earth (or one considered approximately as such)!

translation

(#192) Globus INK (Индикатор Навигационный Космический)

The Soviet space program used controls and instruments completely different from those of American spacecraft. One of the most interesting navigation instruments aboard the Soyuz spacecraft was the “Globus”, which used a rotating globe to indicate the spacecraft's position above the Earth. This navigation instrument was an electromechanical analog computer using a complex system of gears, cams, and differentials to calculate the spacecraft's position. Officially, this device was called the "Space Navigation Indicator" with the Russian acronym ИНК (ENCRE):

Figure 112 Globus INK

The Globus's primary purpose was to indicate the spacecraft's position. The globe rotated while a fixed reticle on the plastic dome displayed the spacecraft's position. This allowed the globe to correspond to the cosmonauts' view of Earth, enabling them to confirm their position. Latitude and longitude dials located beside the globe provided a numerical indication of the

position. A light/shadow dial at the bottom indicated when the spacecraft would be illuminated by the sun or in shadow—important information for docking. The Globus also included an orbit counter that displayed the number of orbits completed.

The Globus had a second mode, indicating where the spacecraft would land if the retrorockets were activated to initiate landing. A switch allowed the globe to be rotated until the landing position was under the reticle, enabling the cosmonauts to assess the suitability of that landing site.

The cosmonauts configured the Globus by turning knobs to set the spacecraft's initial position and orbital period. From there, the Globus electromechanically tracked the orbit. Unlike the Apollo guidance computer, the Globus did not receive navigation information from an inertial measurement unit (IMU) or other sources; therefore, it did not know the spacecraft's actual position. It simply displayed the predicted position.

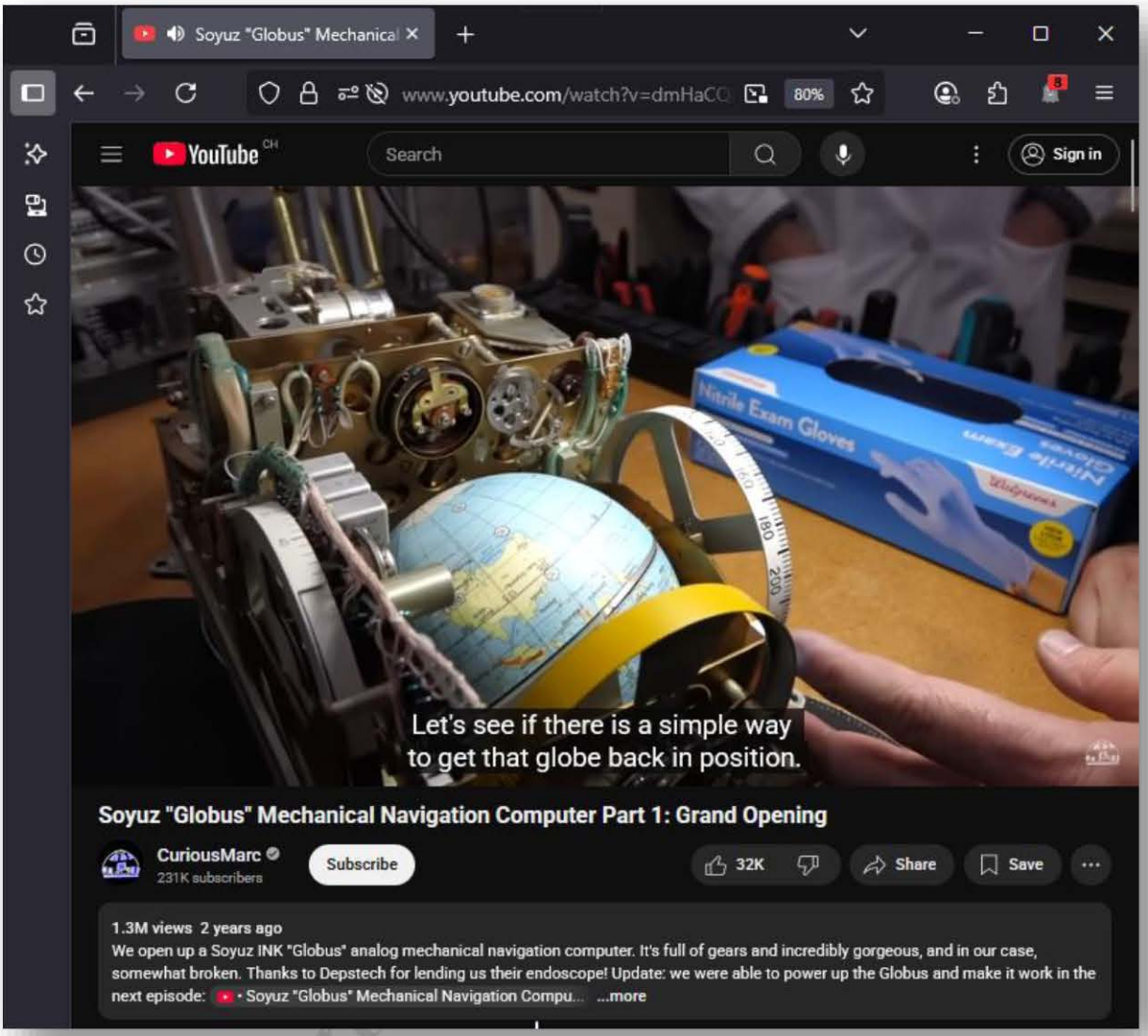
Figure 113 The Neptun-M IDS for the Soyuz-TM

More details on the operation, mechanics and electronics of this instrument are available here:

https://www.righto.com/2023/01/inside-globus-ink-mechanical-navigation.html#fn:ink

And numerous YouTube videos dissecting the device are available, including, for example:

https://www.youtube.com/watch?v=dmHaCQ8Ul6E


Soyuz "Globus" Mechanical
www.youtube.com/watch?v=dmHaCC
80%
YouTube CH
Search
Sign in
Nitrile Exam Gloves
Let's see if there is a simple way
to get that globe back in position.
Soyuz "Globus" Mechanical Navigation Computer Part 1: Grand Opening
CuriousMarc
231K subscribers
Subscribe
32K
Share
Save
1.3M views 2 years ago
We open up a Soyuz INK "Globus" analog mechanical navigation computer. It's full of gears and incredibly gorgeous, and in our case, somewhat broken. Thanks to Depstech for lending us their endoscope! Update: we were able to power up the Globus and make it work in the next episode: • Soyuz "Globus" Mechanical Navigation Compu...
...more

translation

(#193) Equatorial mount

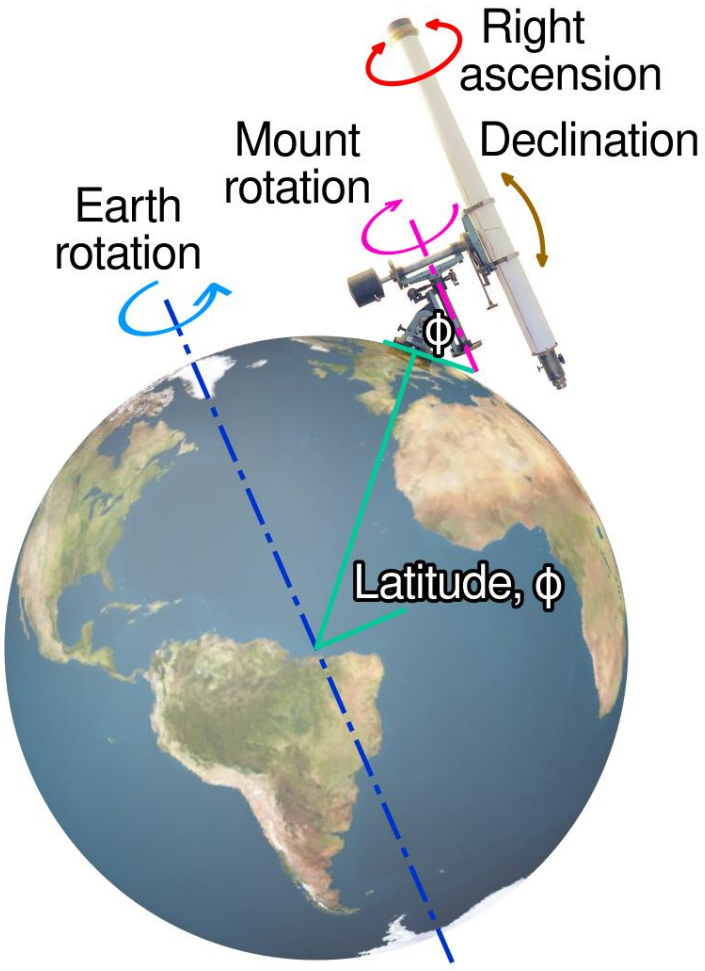
An equatorial mount is designed to track the movement of the stars by compensating for the Earth's rotation. Here's why it proves that the Earth is a sphere:

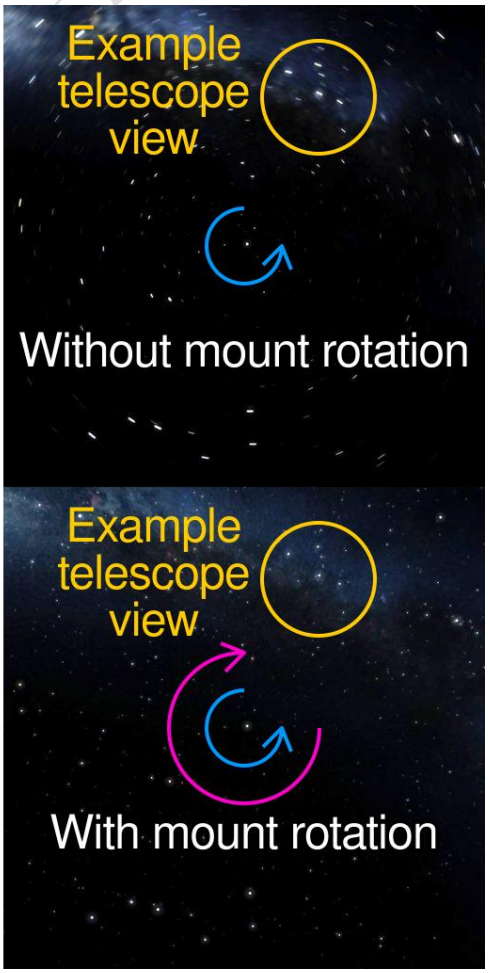
1. **Alignment with the Earth's rotation axis:** The equatorial mount must be aligned with the Earth's rotation axis to function correctly. This means it must be tilted according to the observer's latitude, which would be meaningless on a flat Earth.

2. **Star tracking:** On a spherical Earth, stars appear to move in arcs around the celestial poles. The equatorial mount allows these arcs to be tracked by adjusting a single axis, which would be impossible if the Earth were flat, as the stars would move differently.

3. **Accuracy of observations:** Astronomers use equatorial mounts for precise observations and astronomical photography. The accuracy of these instruments relies on the understanding that the Earth is a rotating sphere.

These points show that the design and use of equatorial mounts are based on the model of a spherical Earth, thus confirming its shape!





The fact that the observable operation of an equatorial mount is incompatible with a flat Earth can be easily experienced with the observation angles, for example with Polaris (North Star/Polar Star):

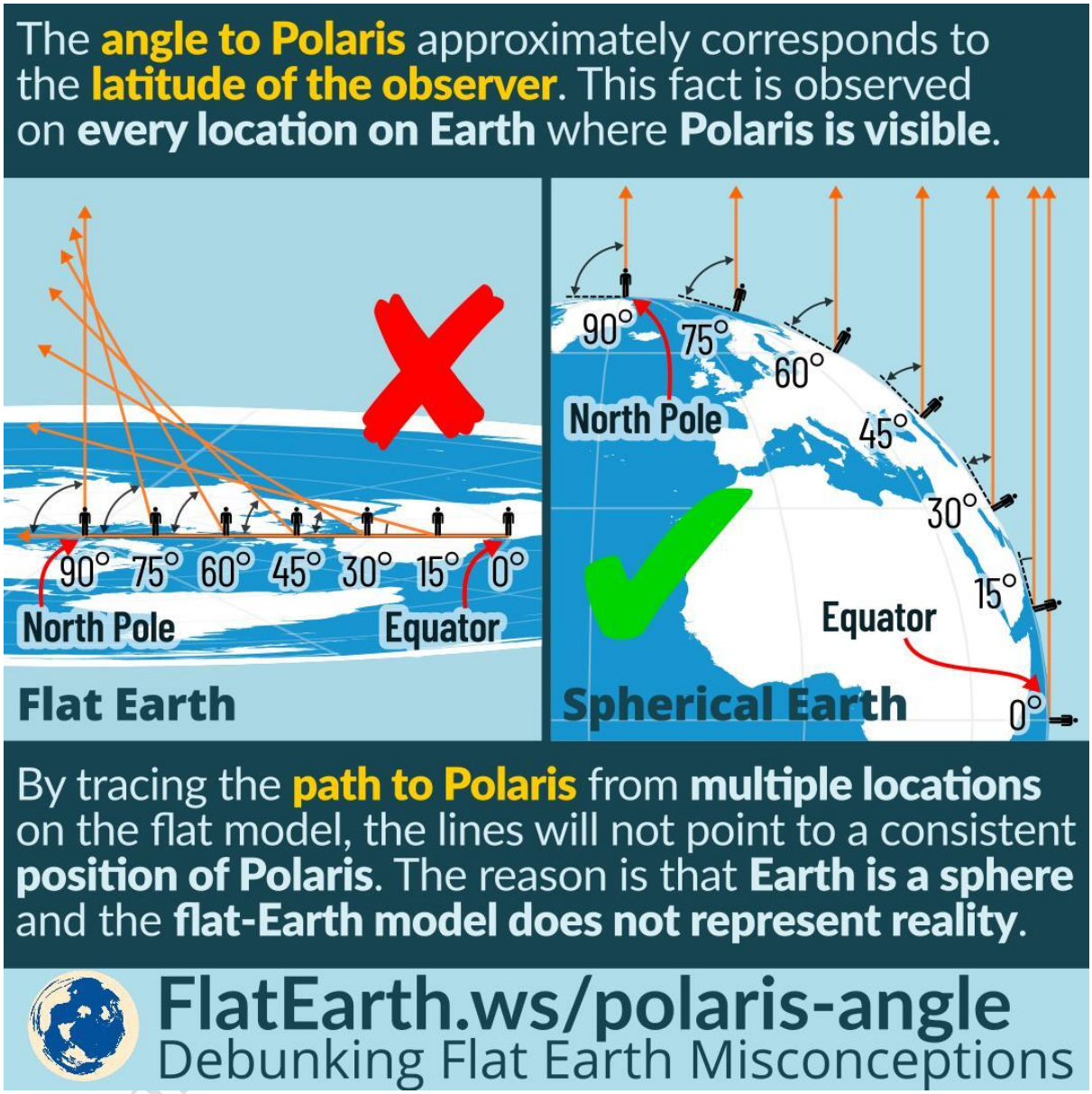
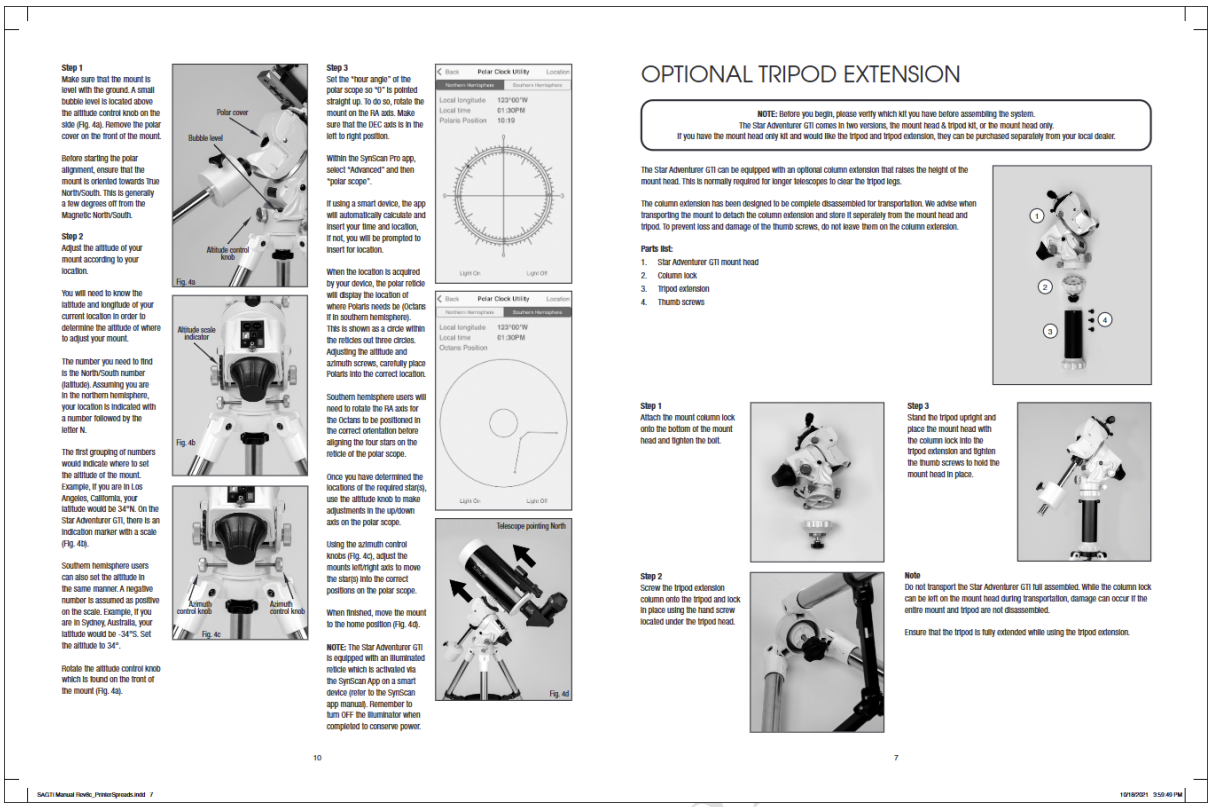

The angle to Polaris approximately corresponds to the latitude of the observer. This fact is observed on every location on Earth where Polaris is visible.
90° 75° 60° 45° 30° 15° 0°
North Pole
Equator
Flat Earth
90°
75°
60°
45°
30°
15°
0°
North Pole
Equator
Spherical Earth
By tracing the path to Polaris from multiple locations on the flat model, the lines will not point to a consistent position of Polaris. The reason is that Earth is a sphere and the flat-Earth model does not represent reality.
FlatEarth.ws/polaris-angle
Debunking Flat Earth Misconceptions

Figure 114 Polaris observation angle on a globe (source : FlatEart.ws/polaris-angle)

The manual for the "StarAdventurer GTI" mount (a portable equatorial mount costing around 600 USD) does not directly mention the globe, but it does mention the latitude adjustment (to compensate for it), and the constellation of Octans to aim at "Sigma Octantis" when in the Southern Hemisphere, and as a reminder: hemisphere = half of a sphere (!):

https://inter-static.skywatcher.com/downloads/sagti_manual_rev8c.pdf



Step 1
Make sure that the mount is level with the ground. A small bubble level is located above the altitude control knob on the side (Fig. 4a). Remove the polar cover on the front of the mount.

Before starting the polar alignment, ensure that the mount is oriented towards True North/South. This is generally a few degrees off from the Magnetic North/South.

Step 2
Adjust the altitude of your mount according to your location.

You will need to know the latitude and longitude of your current location in order to determine the altitude of where to adjust your mount.

The number you need to find is the North/South number (latitude). Assuming you are in the northern hemisphere, your location is indicated with a number followed by the letter N.

The first grouping of numbers would indicate where to set the altitude of the mount. Example, if you are in Los Angeles, California, your latitude would be 34°N. On the Star Adventurer GTi, there is an indication marker with a scale (Fig. 4b).

Southern hemisphere users can also set the altitude in the same manner. A negative number is assumed as positive on the scale. Example, if you are in Sydney, Australia, your latitude would be -34°S. Set the altitude to 34°.

Rotate the altitude control knob which is found on the front of the mount (Fig. 4a).

Polar cover
Bubble level
Altitude control knob
Fig. 4a

Altitude scale indicator
Fig. 4b

Azimuth control knob
Azimuth control knob
Fig. 4c

Step 3
Set the "hour angle" of the polar scope so "0" is pointed straight up. To do so, rotate the mount on the RA axis. Make sure that the DEC axis is in the left to right position.

Within the SynScan Pro app, select "Advanced" and then "polar scope".

If using a smart device, the app will automatically calculate and insert your time and location, if not, you will be prompted to insert for location.

When the location is acquired by your device, the polar reticle will display the location of where Polaris needs be (Octans if in southern hemisphere). This is shown as a circle within the reticles out three circles. Adjusting the altitude and azimuth screws, carefully place Polaris into the correct location.

Southern hemisphere users will need to rotate the RA axis for the Octans to be positioned in the correct orientation before aligning the four stars on the reticle of the polar scope.

Once you have determined the locations of the required star(s), use the altitude knob to make adjustments in the up/down axis on the polar scope.

Using the azimuth control knobs (Fig. 4c), adjust the mounts left/right axis to move the star(s) into the correct positions on the polar scope.

When finished, move the mount to the home position (Fig. 4d).

NOTE: The Star Adventurer GTi is equipped with an illuminated reticle which is activated via the SynScan App on a smart device (refer to the SynScan app manual). Remember to turn OFF the illuminator when completed to conserve power.

Back Polar Clock Utility Location
Northern Hemisphere Southern Hemisphere
Local longitude 123°00'W
Local time 01:30PM
Polaris Position 10:19
Light On Light Off

Back Polar Clock Utility Location
Northern Hemisphere Southern Hemisphere
Local longitude 123°00'W
Local time 01:30PM
Octans Position
Light On Light Off

Telescope pointing North
Fig. 4d

10

OPTIONAL TRIPOD EXTENSION

NOTE: Before you begin, please verify which kit you have before assembling the system.
The Star Adventurer GTi comes in two versions, the mount head & tripod kit, or the mount head only.
If you have the mount head only kit and would like the tripod and tripod extension, they can be purchased separately from your local dealer.

The Star Adventurer GTi can be equipped with an optional column extension that raises the height of the mount head. This is normally required for longer telescopes to clear the tripod legs.

The column extension has been designed to be complete disassembled for transportation. We advise when transporting the mount to detach the column extension and store it seperately from the mount head and tripod. To prevent loss and damage of the thumb screws, do not leave them on the column extension.

Parts list:
1. Star Adventurer GTi mount head
2. Column lock
3. Tripod extension
4. Thumb screws

Step 1
Attach the mount column lock onto the bottom of the mount head and tighten the bolt.

Step 2
Screw the tripod extension column onto the tripod and lock in place using the hand screw located under the tripod head.

Step 3
Stand the tripod upright and place the mount head with the column lock into the tripod extension and tighten the thumb screws to hold the mount head in place.

Note
Do not transport the Star Adventurer GTi full assembled. While the column lock can be left on the mount head during transportation, damage can occur if the entire mount and tripod are not disassembled.

Ensure that the tripod is fully extended while using the tripod extension.

7

SAGTI Manual RevAc_PrinterSpreads.indd 7 10/18/2021 3:50:49 PM

Or the French version (translated by Optique Unterlinden, the Skywatcher importer) of the manual for the HEQ5 and EQ6 mounts, which are equatorial mounts:

translation into eng

Utilisation d'une lentille de Barlow

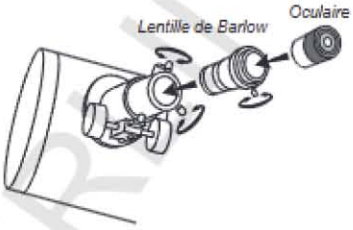
Une lentille de Barlow est une lentille à focale négative qui augmente le grossissement de l'oculaire avec lequel elle est associée, au détriment du champ de vision. Elle allonge le cône de lumière et recule le plan focal de l'instrument de sorte que sa focale résultante paraît plus longue pour l'oculaire.

La lentille de barlow s'insère entre le porte-oculaire et l'oculaire sur un télescope Newton, et généralement entre le renvoi coudé et l'oculaire sur une lunette ou un télescope Maksutov (Fig. f). Dans ce dernier cas, elle peut aussi être placée entre le porte-oculaire et le renvoi coudé pour augmenter encore le facteur de grandissement. Une lentille de Barlow 2x aura un facteur de 2x derrière le renvoi coudé et de 3x devant.

En plus d'augmenter le grossissement de l'oculaire, la lentille de Barlow en augmente le relief d'oeil et en diminue l'aberration de sphéricité. Le plus gros avantage est qu'elle permet de doubler virtuellement le nombre d'oculaires que vous possédez.

Fig.f

(Lunettes astronomiques et télescopes Maksutov)

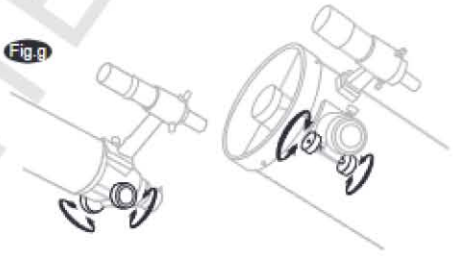


(Télescopes Newton)

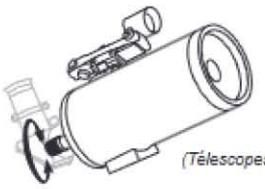
Mise au point de l'image

Tournez lentement les molettes de mise au point (Fig. g), dans un sens ou dans l'autre, jusqu'à ce que l'image soit nette. La mise au point doit être fréquemment retouchée pendant l'observation, du fait des variations thermiques, des flexions, etc. Ces variations sont particulièrement marquées sur les télescopes à courtes focales, lorsqu'ils n'ont pas été mis en température. Enfin, la mise au point est souvent nécessaire lors des changements d'oculaires et lors de l'ajout d'une lentille de Barlow. Un réglage de dureté existe sur certains instruments. Son serrage exagéré peut endommager la crémaillère ou le Crayford.

Fig.g



(Lunettes astronomiques) *(Télescopes Newton)*



(Télescopes Maksutov)

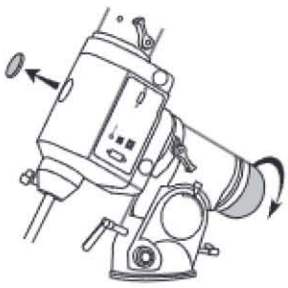
Mise en station

Préparer la monture

Ce chapitre décrit les différentes procédures de mise en station polaire des montures HEQ5 et NEQ6. Avant toute mise en station, il est nécessaire de préparer la monture. Dans l'hémisphère Nord, cela consiste à calibrer puis à aligner le viseur polaire. Dans l'hémisphère Sud, un simple alignement suffit. Ces étapes, qui ne doivent être réalisées qu'une seule fois, seront les premières à être passées en revue.

Si votre monture a déjà été préparée, vous pouvez passez directement au paragraphe intitulé "Procédure de mise en station précise des montures HEQ5/NEQ6". Si ce n'est pas le cas, suivez les étapes ci-dessous pour la préparer.

Fig.h



(Schéma valable pour les 2 types de monture)

COPYRIGHTED

(#194) Night sky

The stars, nebulae, galaxies, clusters and superclusters visible through amateur telescopes or professional observatories are not the same between the Southern and Northern Hemispheres, and this fact, observable by anyone, is totally in contradiction with the flat Earth model.

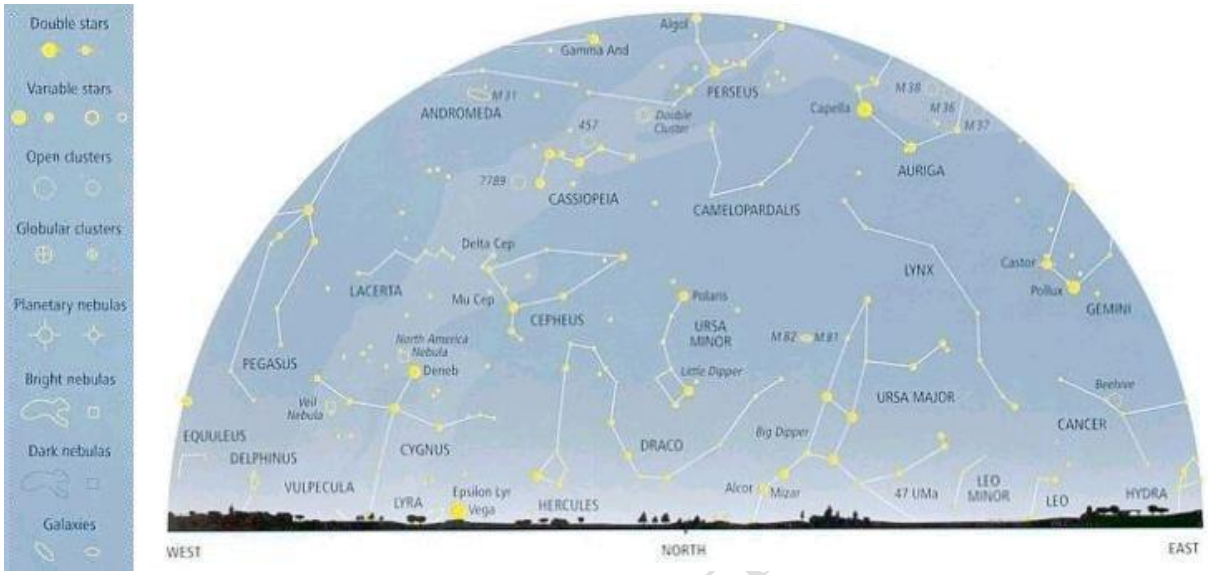


Figure 115 Actual Northern Hemisphere night sky

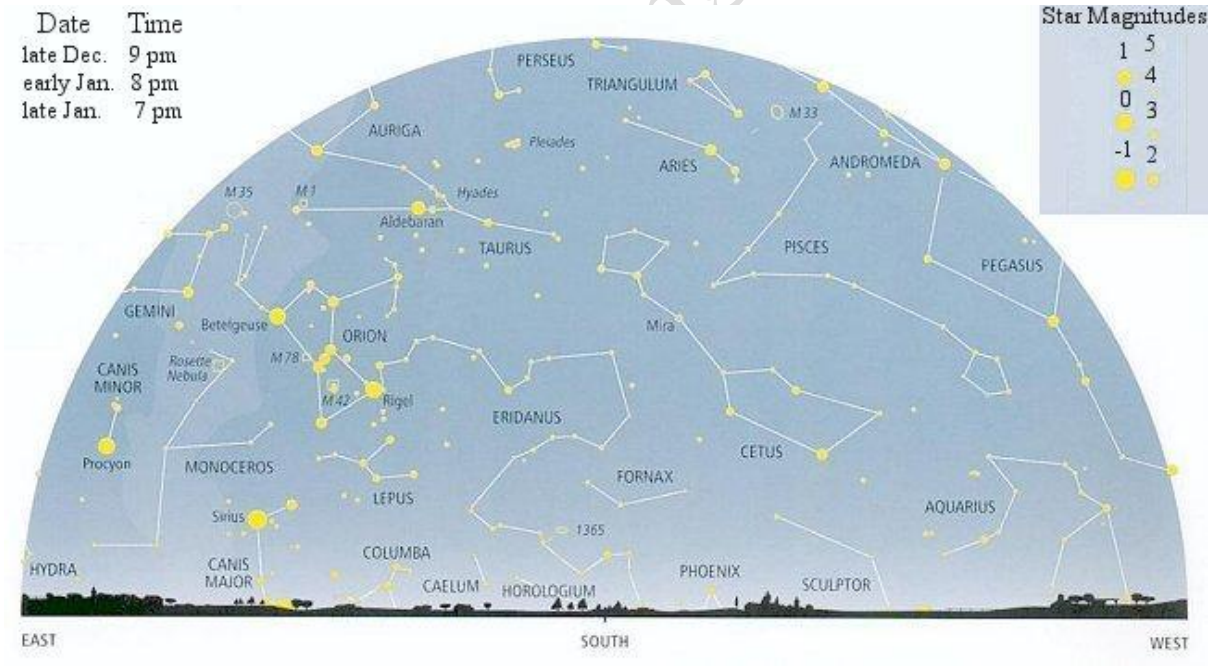


Figure 116 Actual Southern Hemisphere night sky

Or, for those who prefer a more school perspective:

Or in the reality (with real photos):

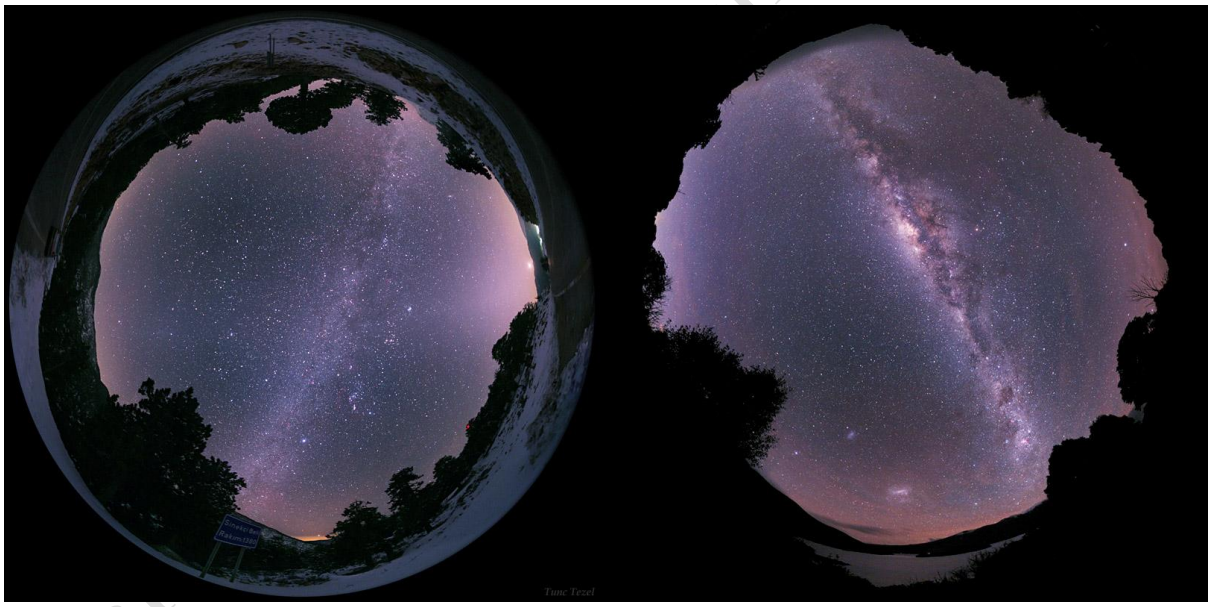


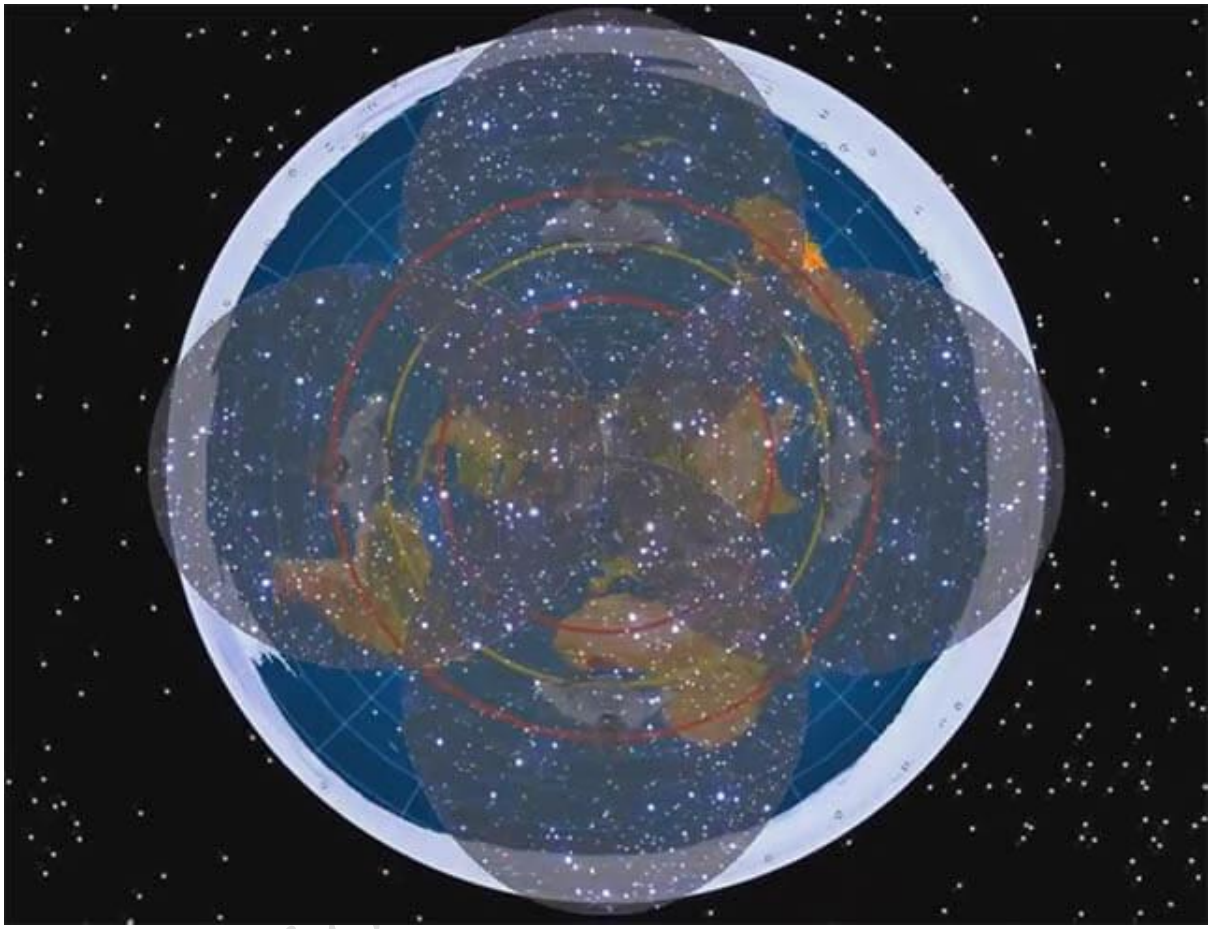
Figure 117 Night sky photos, northern vs. southern hemisphere (author: Tunc Tezel)

The two views of the entire sky compared during a winter night in Turkey in the Northern Hemisphere (February 21, 2009, left) and during a similar winter night in New Zealand in the Southern Hemisphere (July 3, 2010, right).

On the left, the Milky Way and zodiacal light are captured from the Sinekci Pass in the Toros Mountains of southern Turkey, en route to Kas on the Mediterranean coast. The image on the right was taken from Tongariro National Park, New Zealand's oldest protected area and also a UNESCO World Heritage Site. On a dark site above Lake Rotoaira, just south of the large Lake Taupo on New Zealand's North Island, the Milky Way stretches across the southern sky in all its glory. Our galactic neighbors, the Large and Small Magellanic Clouds, rise above

the southern horizon. The bright stars Alpha and Beta Centauri are located in the lower right, near the Southern Cross.

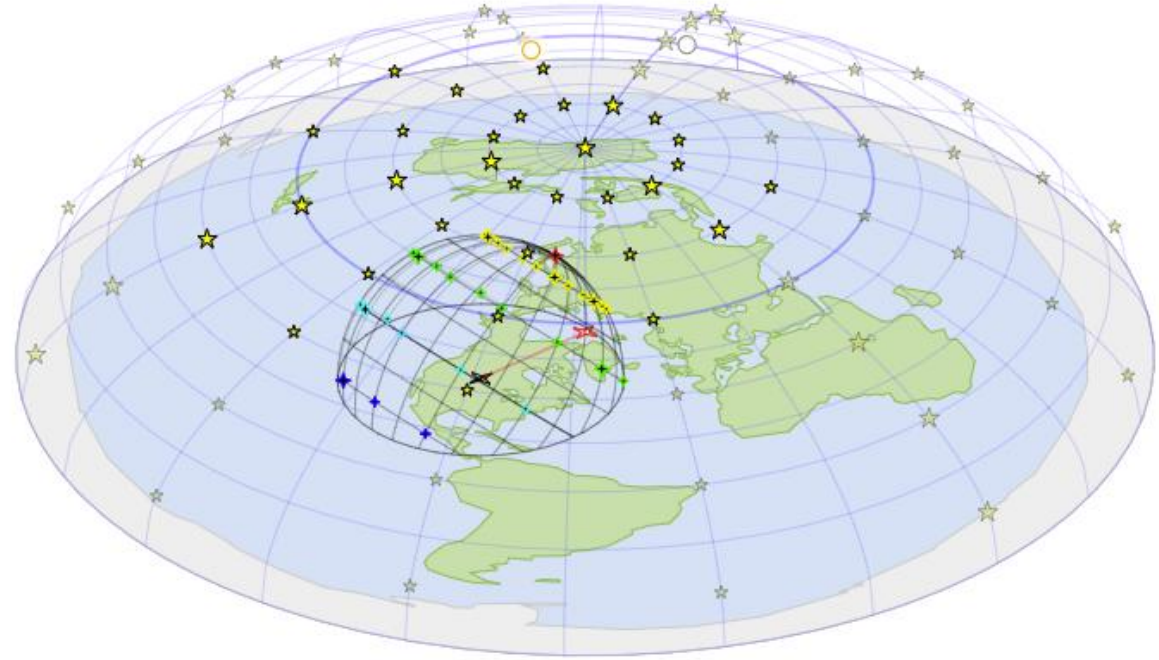
To explain this anomaly, flat-Earthers argue that there are multiple small celestial domes above the flat Earth and that these mini-domes don't rotate in the same direction depending on the latitude… LOL

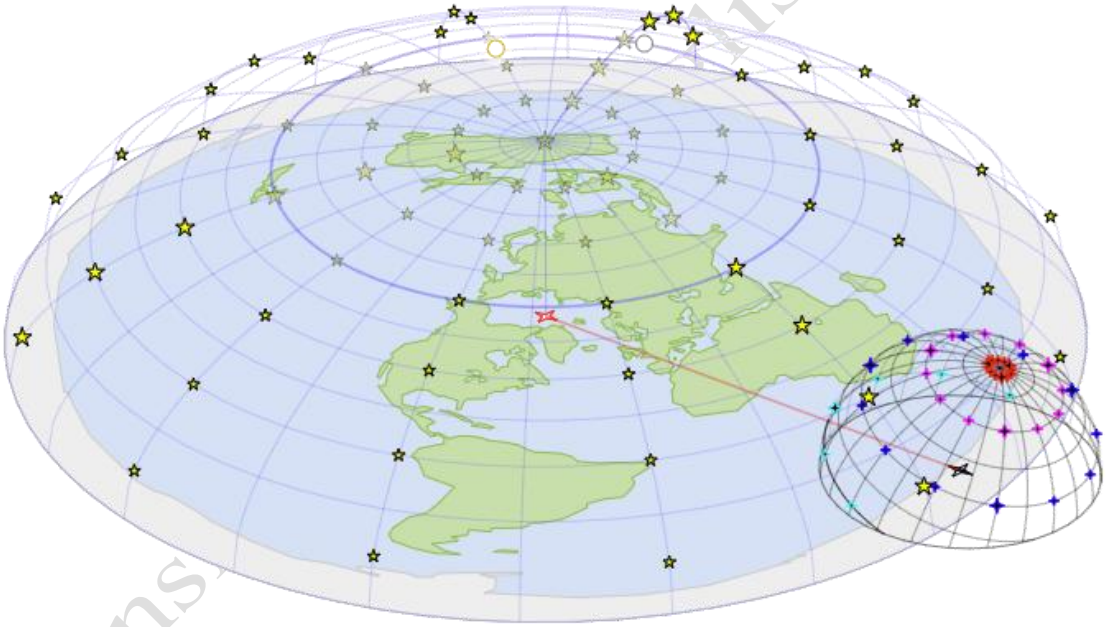


Or done with the online simulator:

http://walter.bislins.ch/bloge/index.asp?page=Flat+Earth+Dome+Model&state=--6~73.115578-1~0.30150754-11.3165829-1~54.874372-130.719598-2111.11055-27461.8342-10-10-51-10-10-20.90201005-3

translatio





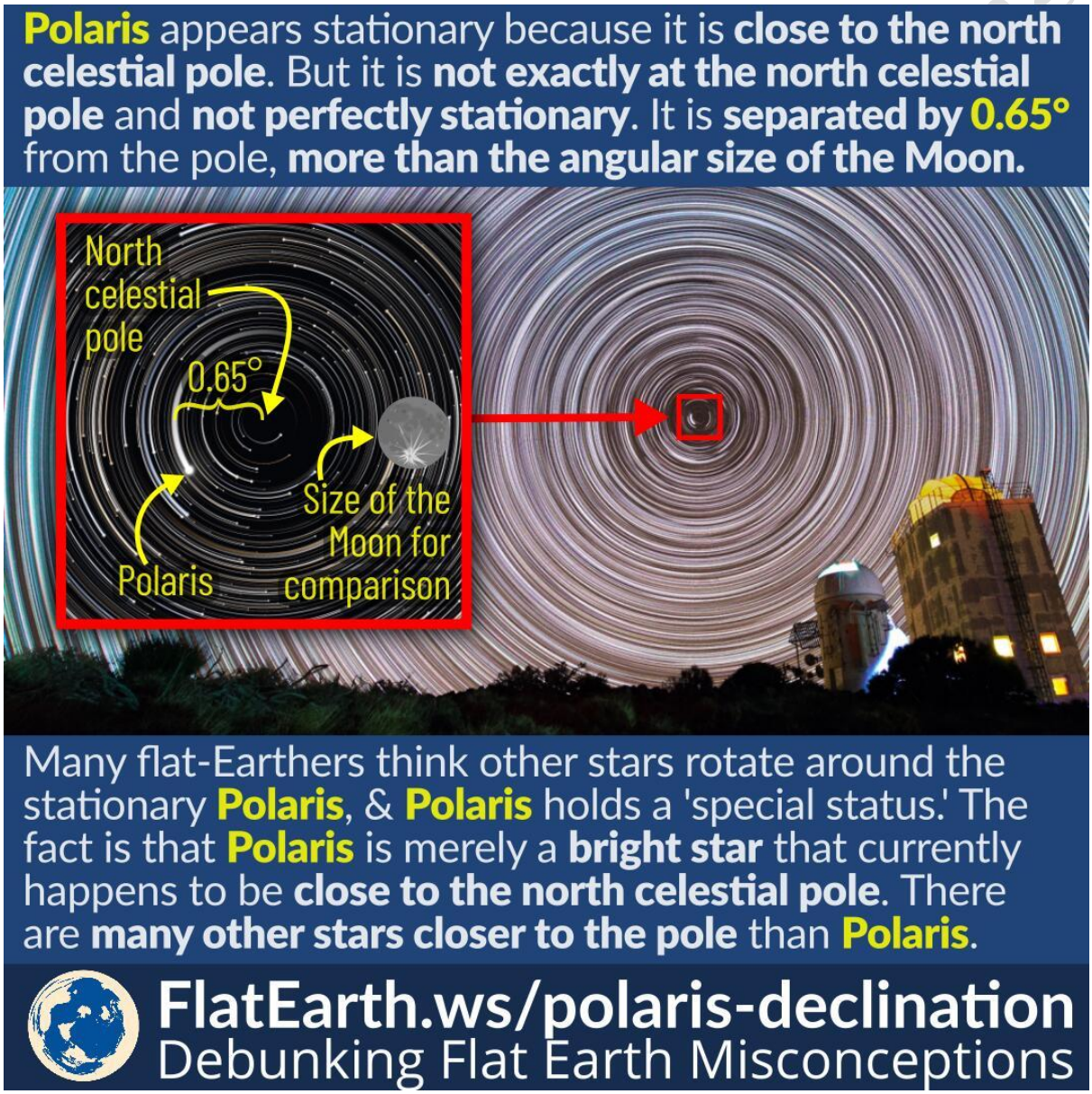
This speaks for itself…

Polaris (North Star)

Several claims made by flat-Earthers regarding Polaris and the celestial North Pole demonstrate that the Earth is not flat. Let's look at the two most common claims:

(#195) Movement of the celestial North Pole

According to flat Earth proponents, Polaris is the star on which the axis of rotation of the flat Earth is located, and since the flat Earth is fixed, it must forever remain Polaris in their paradigm.


Polaris appears stationary because it is close to the north celestial pole. But it is not exactly at the north celestial pole and not perfectly stationary. It is separated by 0.65° from the pole, more than the angular size of the Moon.
North celestial pole
0.65°
Size of the Moon for comparison
Polaris
Many flat-Earthers think other stars rotate around the stationary Polaris, & Polaris holds a 'special status.' The fact is that Polaris is merely a bright star that currently happens to be close to the north celestial pole. There are many other stars closer to the pole than Polaris.
FlatEarth.ws/polaris-declination
Debunking Flat Earth Misconceptions

…but since the Earth is not flat but a sphere that undergoes nutation and precession (Opera Magistris, 2024), the position of Polaris changes on the scale of only a few generations! Indeed, here is the position of Polaris as reported by the British Nautical Almanac over almost 200 years:

1834 edition

JANUARY.

Days of the Month.	α URSÆ MINOR. R. A.	Dec. N.	β
	h m	° ′	
	1 0	88 25	18
	s	″	
1	35·87	39·47	33
2	35·09	39·33	32

1923 edition

Name of Star.	Declination. ° ′ ″
43 H. Cephei . . .	+85 50 41.77
α Ursæ Min. (*Polaris*) .	+88 53 34.33
4 G. Octantis . .	−85 9 32.70
Groombridge 750 .	+85 21 5.69
Groombridge 944 .	+85 9 42.71
31 G. Mensæ . . .	−84 49 38.84
ζ Mensæ . . .	−80 44 2.02
51 H. Cephei . . .	+87 10 21.62
7 G. Octantis . .	−86 54 45.50
25 H. Camelopardalis .	+82 33 51.51
Groombridge 1110	+88 51 51.05

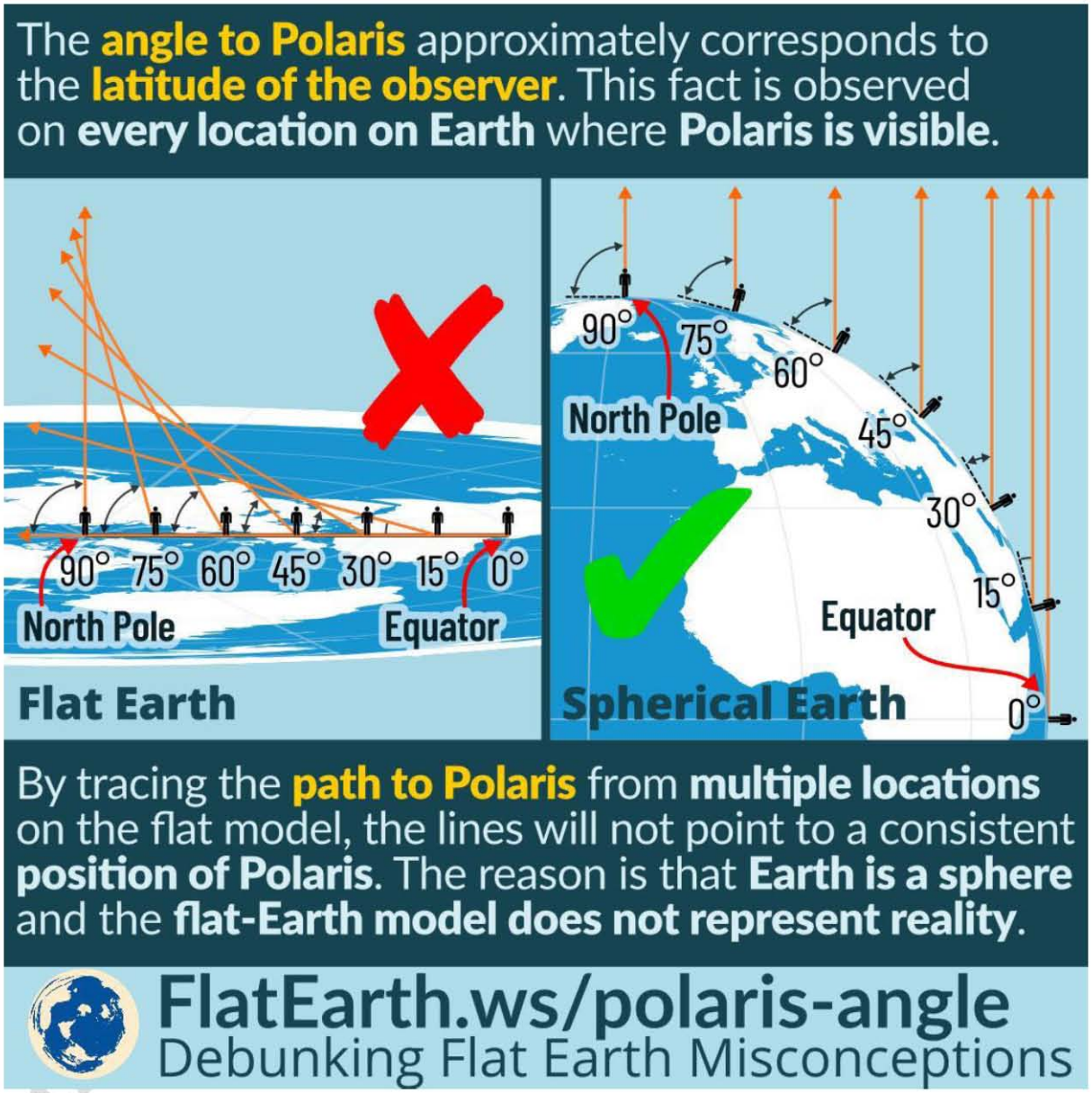
2018 edition

			h m s	° ′ ″
	Per	840	02 51 45.5	+38 23 37
τ^2	Eri	850	02 51 52.7	−20 55 43
η	Per	834	02 52 03.6	+55 58 15
σ	Ari	847	02 52 31.1	+15 09 26
R	Hor	868	02 54 29.7	−49 48 53
α	UMi	424	02 55 00.0	+89 20 31
τ	Per	854	02 55 34.9	+52 50 13
η	Eri	874	02 57 19.9	−08 49 32
		875	02 57 33.2	−03 38 20
θ^1	Eri	897	02 58 57.8	−40 13 53
	Per	882	03 00 12.8	+35 15 22
		896	03 09 12.6	+08 58 48

translation into english ongoing

(#196) Angle of observation of the star Polaris

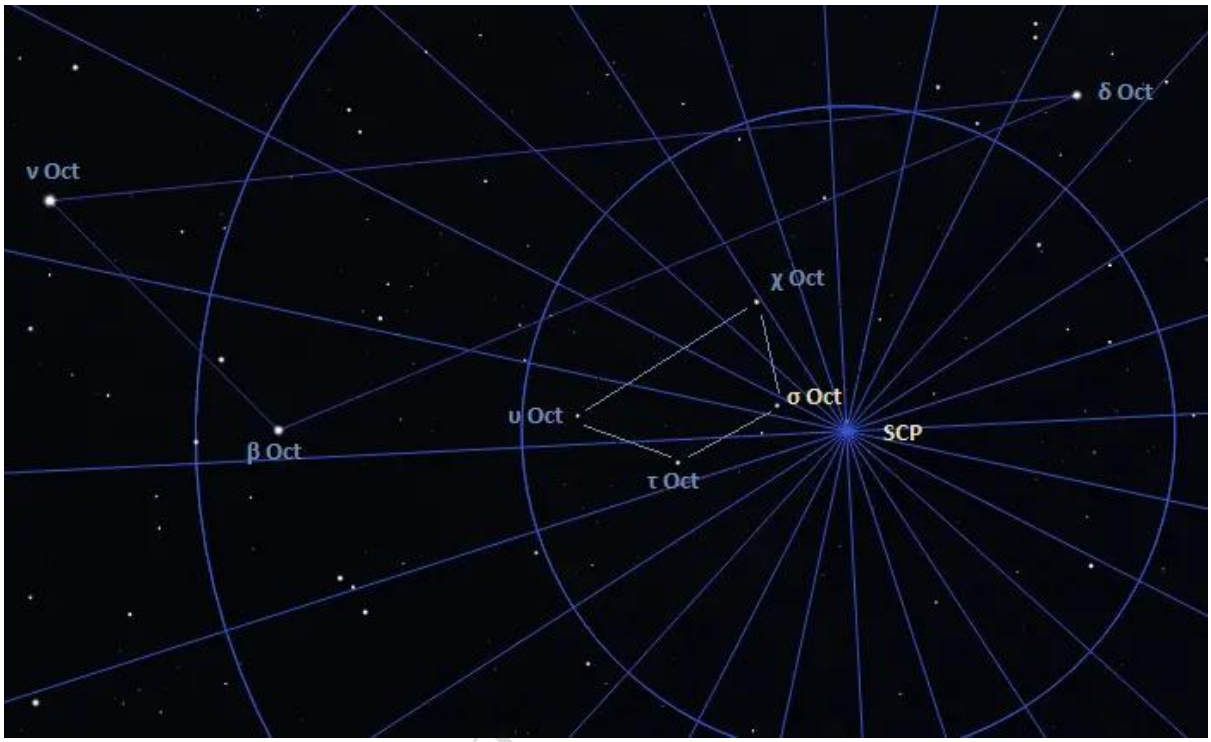
Another inexplicable absurdity of the flat-Earth model is that the angle relative to Polaris in real life that is measurable, controllable, repeatable, and undeniable corresponds approximately to the observer's latitude. This fact is observed at every location on Earth where Polaris is visible.


The angle to Polaris approximately corresponds to the latitude of the observer. This fact is observed on every location on Earth where Polaris is visible.
90° 75° 60° 45° 30° 15° 0°
North Pole
Equator
Flat Earth
90°
75°
60°
45°
30°
15°
0°
North Pole
Equator
Spherical Earth
By tracing the path to Polaris from multiple locations on the flat model, the lines will not point to a consistent position of Polaris. The reason is that Earth is a sphere and the flat-Earth model does not represent reality.
FlatEarth.ws/polaris-angle
Debunking Flat Earth Misconceptions

(#197) Sigma Octantis (North Star of the Southern Hemisphere)

Flat Earth proponents are unable to explain that there is an apparent fixed point in the Southern Hemisphere, given that for them Antarctica is a ring-shaped region…

Sigma Octantis is a star with an apparent magnitude of 5.42 located in the constellation Octans. It is (actually…) the closest star visible to the naked eye to the celestial south pole.



In the Southern Hemisphere the stars rotate in the opposite direction to those in the Northern Hemisphere, which is obviously incompatible with the model of flat Earth proponents.

Obviously, we still have the problem that at night, Polaris is not visible from the Southern Hemisphere and conversely, the Southern Cross constellation is not visible from the Northern Hemisphere:

translation in

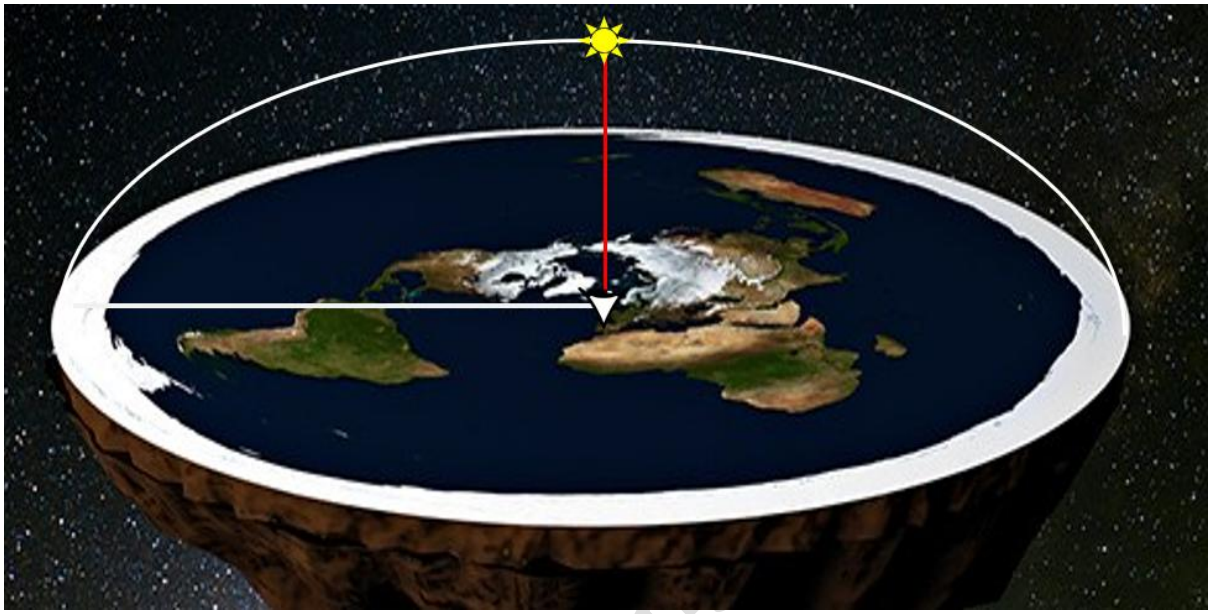
that cannot be explained by flat Earth proponents! Indeed, as illustrated below, observers looking in strictly opposite directions should see the same constellation according to flat Earth proponents (LoL!).

translation

(#198) Star declination

Flat Earth proponents are unable to explain the angular declinations of stars in their model. They invoke perspective rhetorically but are unable to provide the details of the calculations.

Let's take, for example, the case of Polaris again, based on the flat Earth model:



On a flat Earth, the angle of Polaris is therefore 90° at the North Pole – at the level of the dome.

In the flat Earth model, Polaris is supposed to be visible everywhere:

translation into en

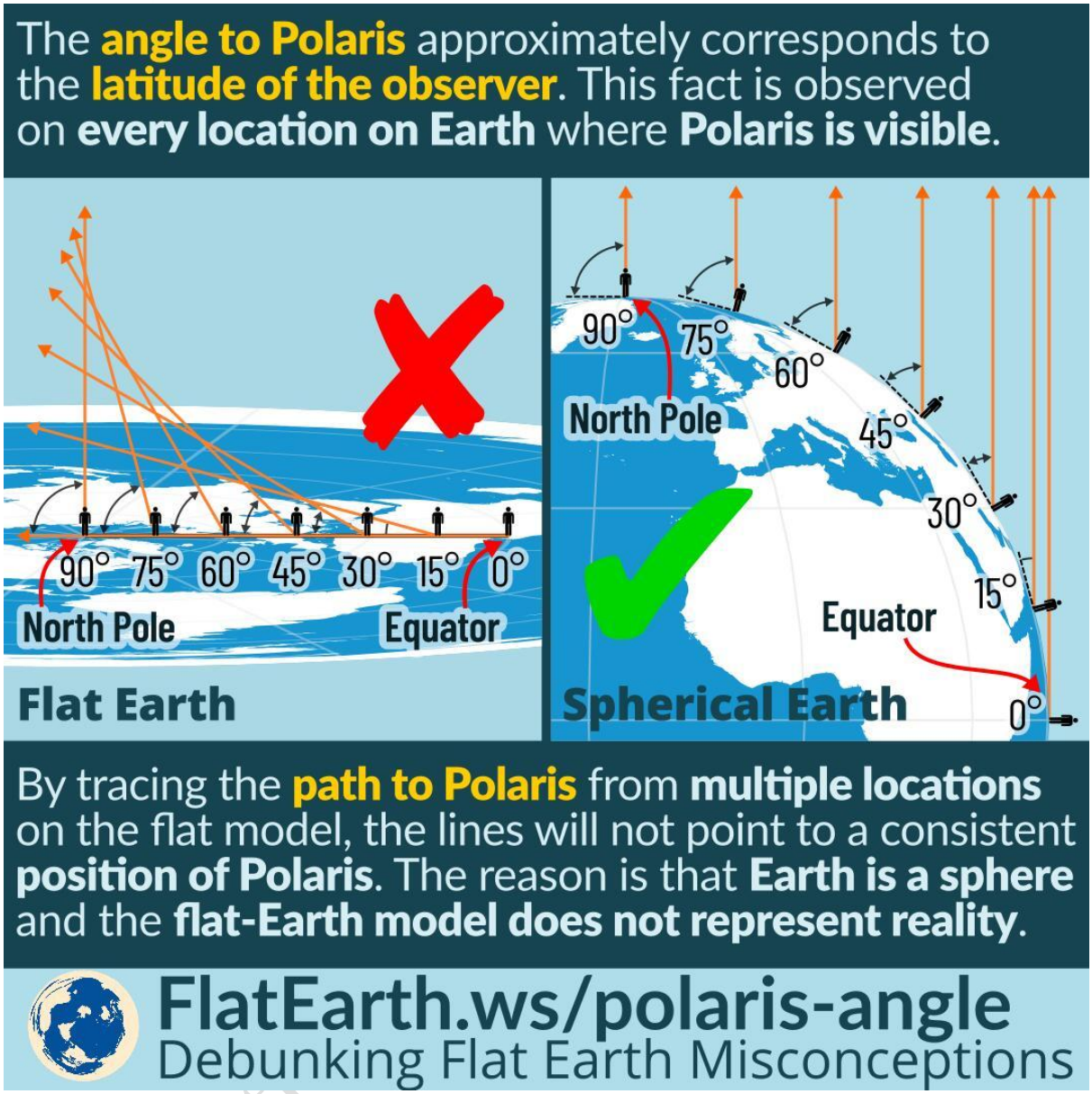
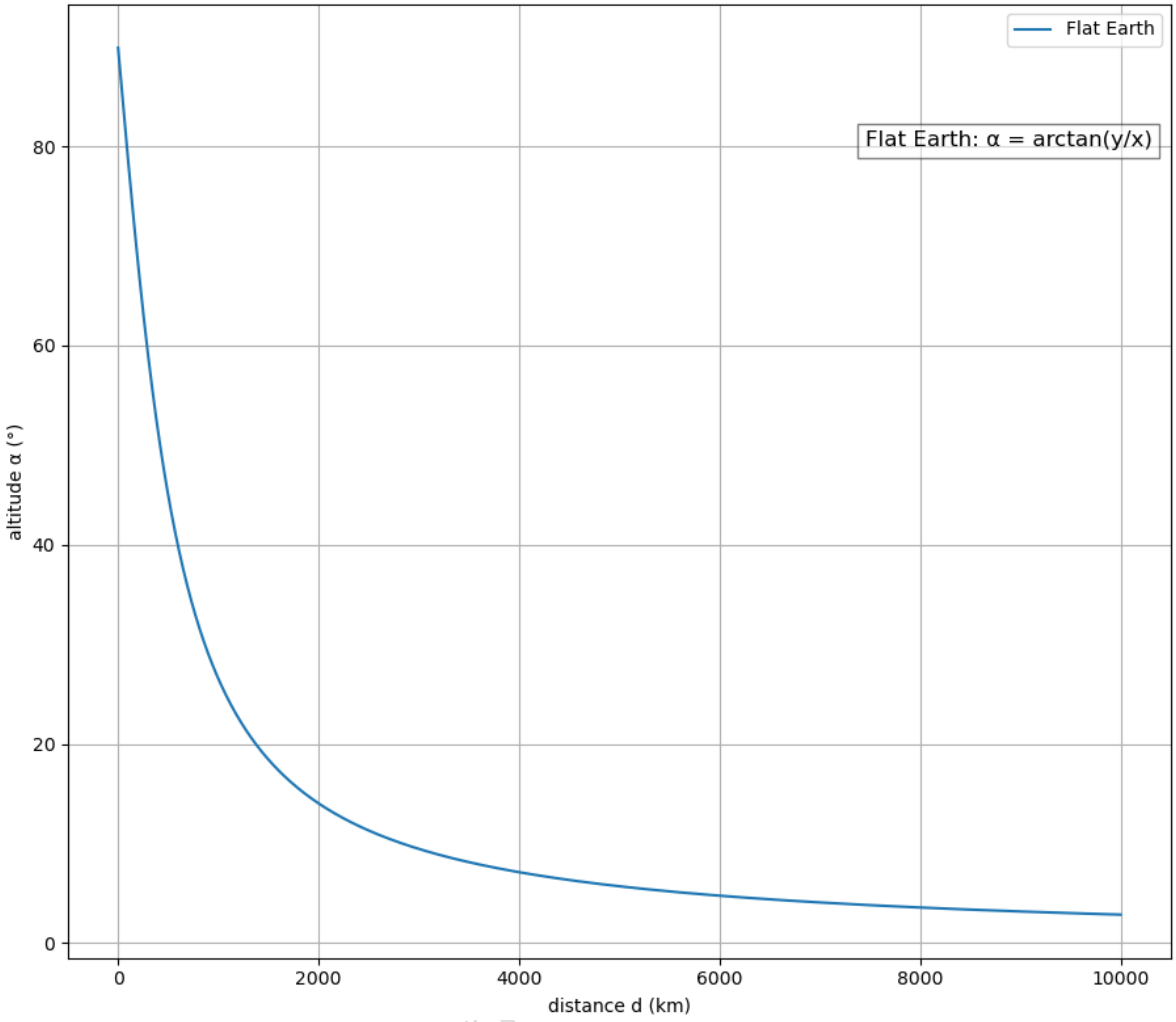

The angle to Polaris approximately corresponds to the latitude of the observer. This fact is observed on every location on Earth where Polaris is visible.
90° 75° 60° 45° 30° 15° 0°
North Pole
Equator
Flat Earth
90°
75°
60°
45°
30°
15°
0°
North Pole
Equator
Spherical Earth
By tracing the path to Polaris from multiple locations on the flat model, the lines will not point to a consistent position of Polaris. The reason is that Earth is a sphere and the flat-Earth model does not represent reality.
FlatEarth.ws/polaris-angle
Debunking Flat Earth Misconceptions

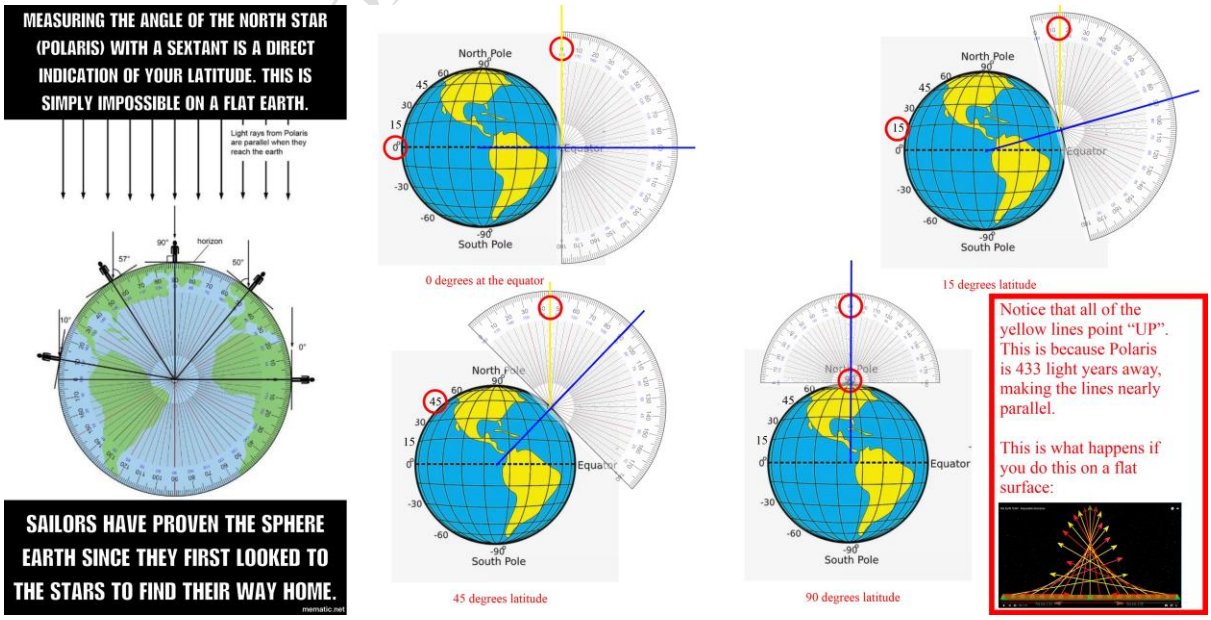
Figure 118 Déclinaison impossible sur la Terre plate (https://flatearth.ws/c/polaris)

Or in graphical form:

translation

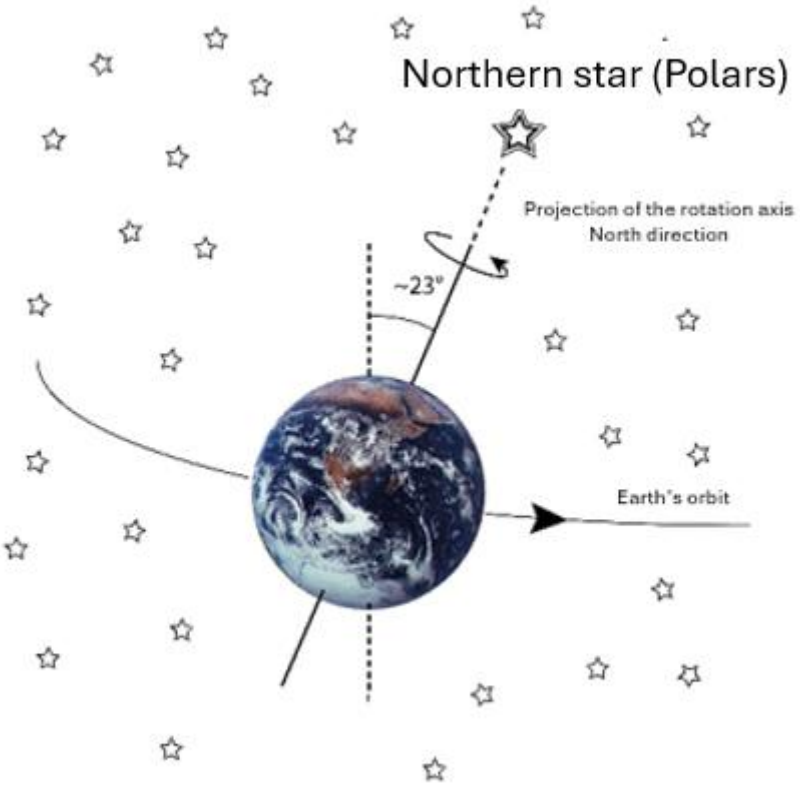


So there is a again a blatant contradiction between reality and the models of flat Earth proponents!


MEASURING THE ANGLE OF THE NORTH STAR (POLARIS) WITH A SEXTANT IS A DIRECT INDICATION OF YOUR LATITUDE. THIS IS SIMPLY IMPOSSIBLE ON A FLAT EARTH.
Light rays from Polaris are parallel when they reach the earth
horizon
SAILORS HAVE PROVEN THE SPHERE EARTH SINCE THEY FIRST LOOKED TO THE STARS TO FIND THEIR WAY HOME.
North Pole
South Pole
Equator
0 degrees at the equator
15 degrees latitude
45 degrees latitude
90 degrees latitude
Notice that all of the yellow lines point "UP". This is because Polaris is 433 light years away, making the lines nearly parallel.
This is what happens if you do this on a flat surface:

(#199) Apparent prograde and retrograde rotation of the sky

The rotation of stars in the night sky poses a major problem for the flat Earth hypothesis. On a flat Earth, it is difficult to explain why the stars appear to rotate around two different fixed points in the sky, known as the “celestial poles”.



Northern Hemisphere	Ecuador	Southern Hemisphere
In the Northern Hemisphere, the stars rotate prograde around the North celestial pole.	At the equator, the stars go in a straight line except when looking at the other hemispheres (North/South).	In the Southern Hemisphere, the stars rotate in a retrograde fashion around the South celestial pole.

Or even better:

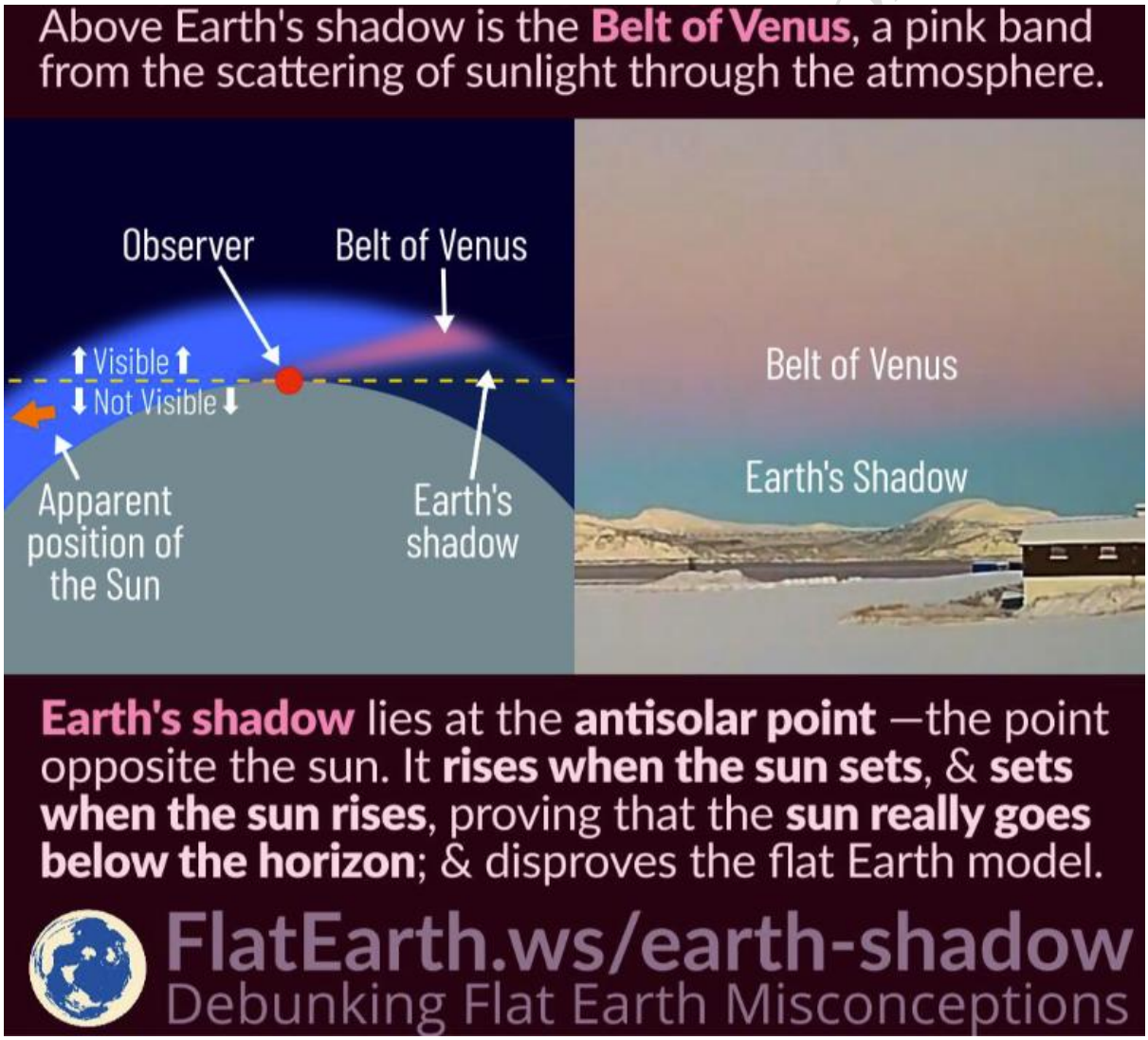
translation into english of

(#200) Anticrepuscular arch (Venus's belt)

The anticrepuscular arch (or "Venus's belt") is a band of sky, usually pinkish, located on the horizon and particularly visible at dawn and dusk. The pinkish color given to this patch of sky is due to backscattering of light waves by the Earth's atmosphere during sunrise and sunset. A similar effect can be observed during a solar eclipse.

The anti-twilight arch extends from 10° to 20° above the horizon. It is separated from the horizon by a dark layer, the dark segment, which is the projection of the Earth's shadow onto its atmosphere.

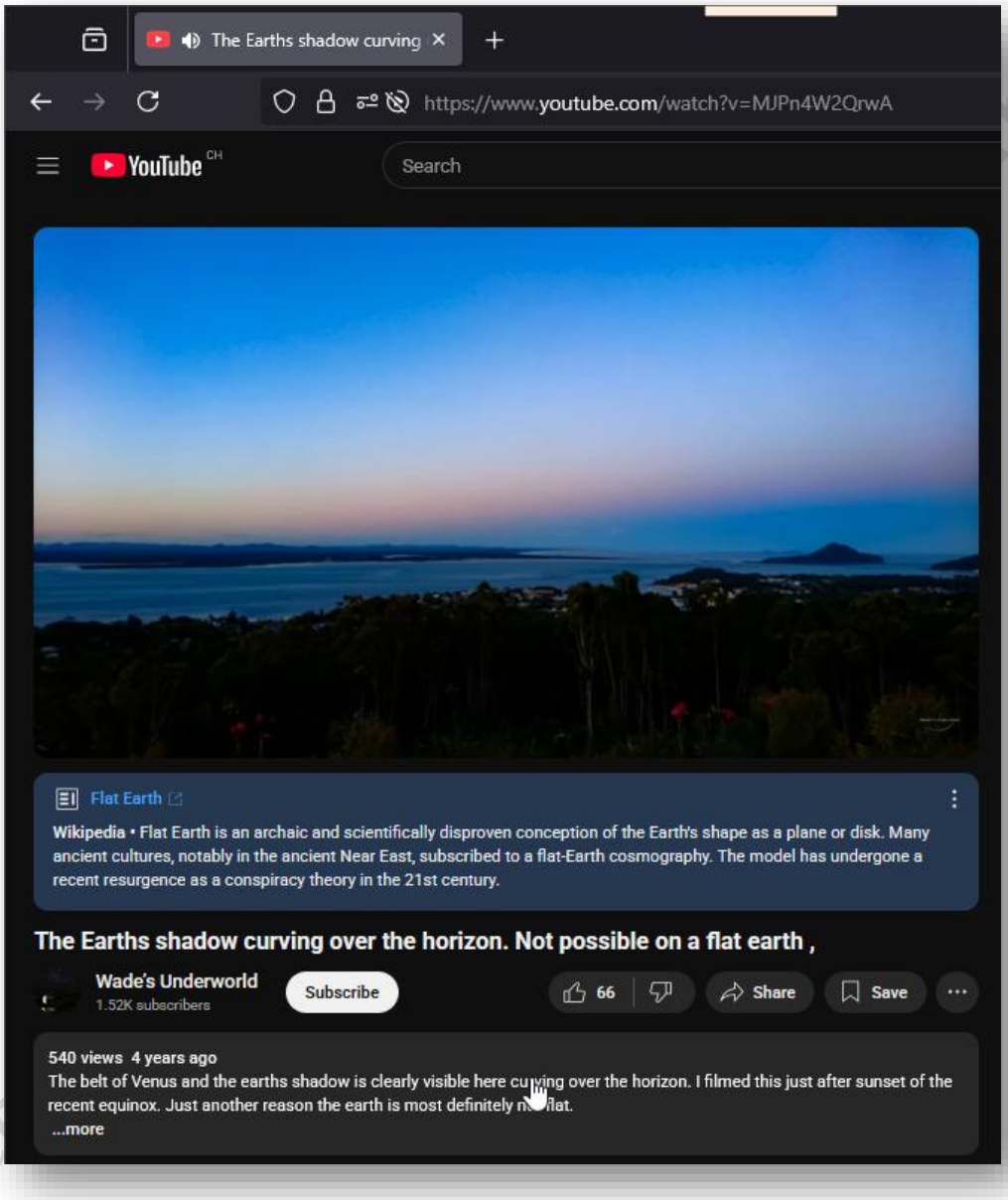
This phenomenon can be observed shortly before sunrise and shortly after sunset. It requires a clear, unobstructed sky. The appearance of this phenomenon is due to the fact that sunlight passes through a greater layer of atmosphere because of its angle of incidence. This thicker layer, compared to the rest of the day, scatters the visible light spectrum more, to the point where only the longer wavelengths in the red range remain.


Above Earth's shadow is the Belt of Venus, a pink band from the scattering of sunlight through the atmosphere.
Observer
Belt of Venus
Visible
Not Visible
Apparent position of the Sun
Earth's shadow
Belt of Venus
Earth's Shadow
Earth's shadow lies at the antisolar point —the point opposite the sun. It rises when the sun sets, & sets when the sun rises, proving that the sun really goes below the horizon; & disproves the flat Earth model.
FlatEarth.ws/earth-shadow
Debunking Flat Earth Misconceptions

The Earth's shadow is located at the antisolar point, that is, the point opposite the Sun. It rises when the Sun sets and sets when the Sun rises, which proves that the Sun actually passes below the horizon and refutes the flat Earth model.

And there's a video on YouTube filming the phenomenon:

https://www.youtube.com/watch?v=MJPn4W2QrwA


The Earths shadow curving
https://www.youtube.com/watch?v=MJPn4W2QrwA
YouTube CH
Search
Flat Earth
Wikipedia • Flat Earth is an archaic and scientifically disproven conception of the Earth's shape as a plane or disk. Many ancient cultures, notably in the ancient Near East, subscribed to a flat-Earth cosmography. The model has undergone a recent resurgence as a conspiracy theory in the 21st century.
The Earths shadow curving over the horizon. Not possible on a flat earth ,
Wade's Underworld
1.52K subscribers
Subscribe
66
Share
Save
540 views 4 years ago
The belt of Venus and the earths shadow is clearly visible here curving over the horizon. I filmed this just after sunset of the recent equinox. Just another reason the earth is most definitely n flat.
...more

(#201) Earth-Moon barycenter and thermal anomaly

The Earth-Moon barycenter is not aligned with the center of the Earth. As a result, during a full moon, when the Moon is farthest from the Sun, the Earth is 4,670 km closer to the Sun than average, while during a new Moon, the Earth is 4,670 km farther from the Sun than average.

The Earth oscillates more than 9,000 km towards and away from the Sun every month! And the increase in incident radiation from the Sun during the phases around the full Moon amounts to about 43 mW per square meter, or an additional 5,450 GW over the whole of the Earth.

The Earth normally receives nearly 44 million gigawatts of solar radiation, so the difference is relatively small, but it is enough to warm the Earth by nearly 0.01 degrees Celsius, which is close to the average monthly temperature variation observed (Evidence of lunar phase influence on global surface air temperature, 2000).

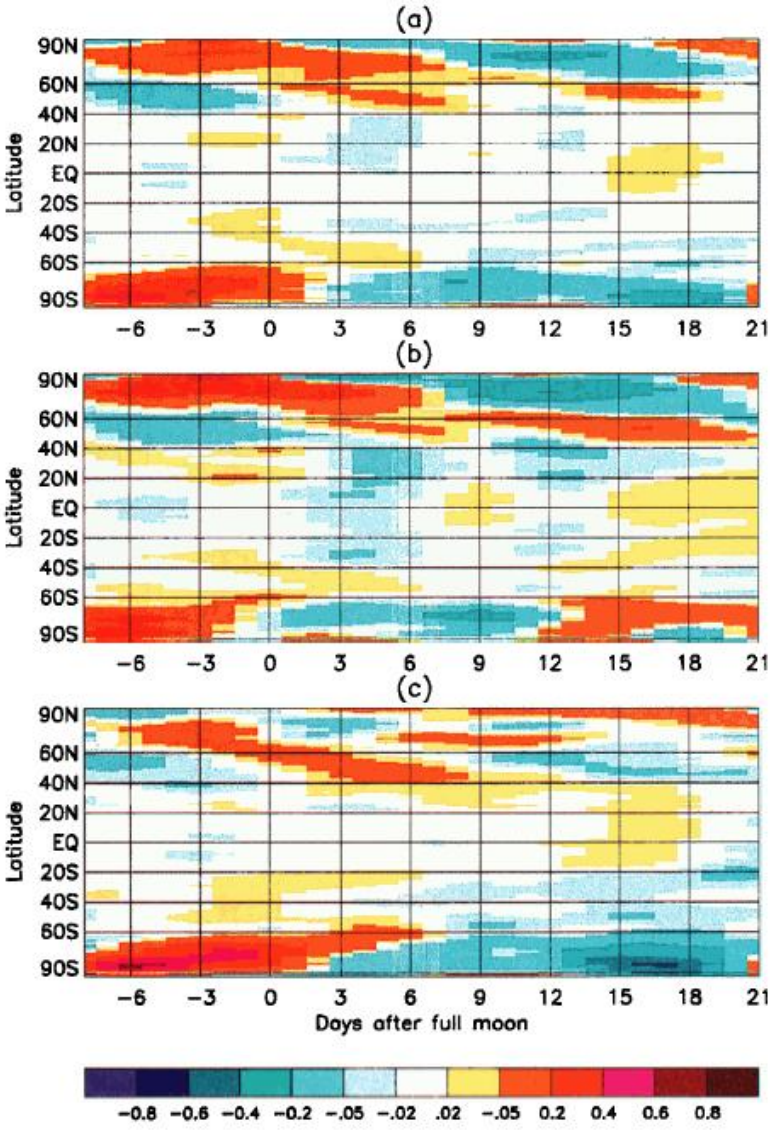


Plate 2. 20-year mean zonally averaged intraseasonal anomalies composited with respect to the date of full moon: (a) annual mean, (b) October-March (NH winter), (c) April-September (SH winter).

This is incompatible with the flat Earth hypothesis, where the Sun is at a fixed height only a few thousand kilometers above the ground. And if the Sun, in the flat Earth model, were to change altitude, this would be an effect easily observable from the surface of the flat Earth (and this has obviously never been observed...).

translation into english ongoing

(#202) Gegenschein (anti-solar glow)

The Gegenschein (German word meaning "opposite glow") or antisolar glow is a faint glow located in the region of the ecliptic directly opposite the Sun.

Similar to zodiacal light, the gegenschein is caused by the reflection of sunlight on dust located mainly in the plane of the ecliptic.

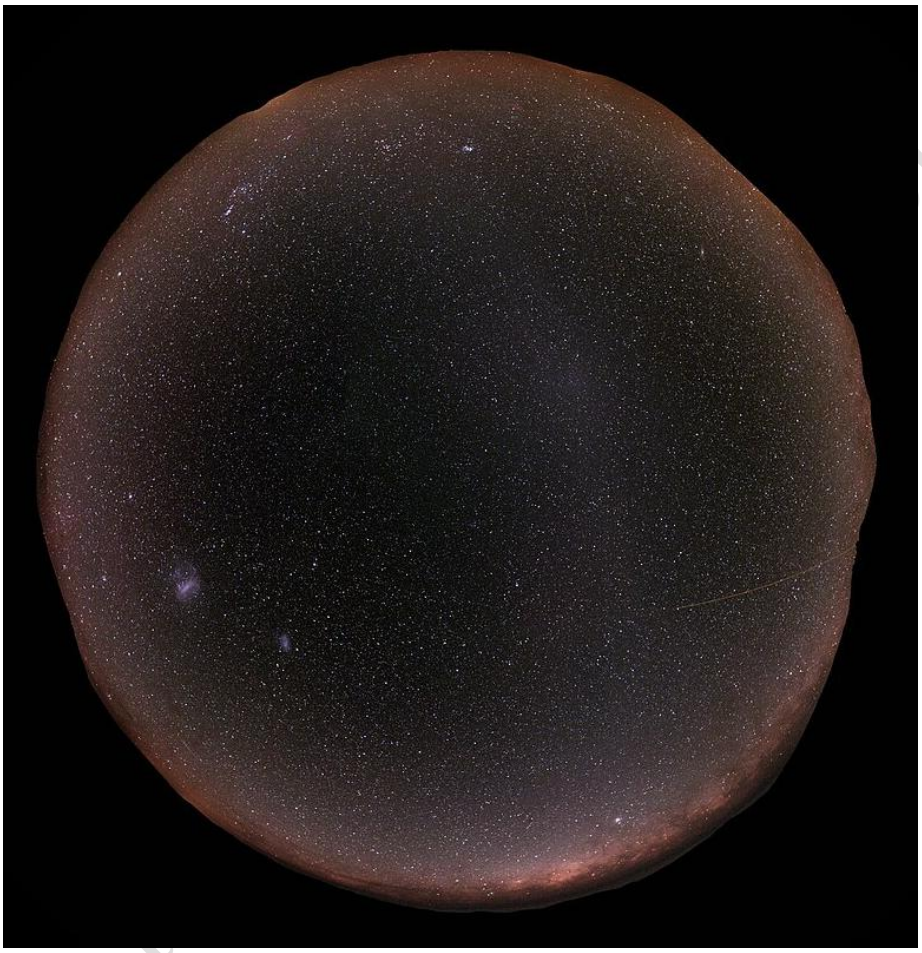


Figure 119 Gegenschein at the Cerro Paranal Observatory (source: Wikipedia, author: ESO/Stéphane Guisard)

The gegenschein appears as a faint glow on the night sky in the region of the Zodiac opposite the Sun, oval in shape, measuring a few degrees wide by 10 to 15° long, oriented along the plane of the ecliptic.

The Gegenschein is so faint that it cannot be seen if the Moon is up or if it is near the Milky Way. The best time to observe it is in autumn, in the constellation Pisces, on a moonless night, and in a location with no light pollution (a Bortle scale site of level 1).

If the Earth is spherical, nighttime corresponds to the moment when the Sun is behind the planet. You should see, in the night sky, the point exactly opposite the direction of the Sun. You should be able to see, in this direction, the backscattered sunlight from the interplanetary dust cloud. Now imagine that the Earth is flat. The Sun shines on a part of the Earth at all times, so it must be above the Earth's plane at all times. In any case, it should never be possible to

look up at the sky in the direction exactly opposite to that of the Sun. Therefore, there should be no point in the night sky with a peak of backscattered sunlight in the case of a flat Earth!

translation into english ongoing

(#203) Meteorite showers

From an observation point on Earth, we can observe meteors. Better than counting with the naked eye, professional astronomers have built specialized radar systems that can detect meteors with greater sensitivity, including during the day, and we can configure them to count meteors all day, every day !

Figure 120 Meteor shower (source: NASA)

Each time the radar detects a meteor, it can record where it was in the sky, which direction it traveled, and what time the event occurred. Thinking specifically about time, we can count the number of meteors arriving during a given hour and average that over several days to produce an hourly rate of meteor events. Many experiments do just that. If the Earth is a geoid rotating in space, orbiting the Sun, we should expect the part of the Earth where dawn breaks, where the local time is around 6:00 a.m., to sweep across more meteors than the part of the Earth where sunset (as it's commonly called...) occurs, where the local time is around 6:00 p.m. And if the Earth is a geoid, this variation should be sinusoidal—the smooth shape characteristic of a wave as traced by points rotating around a circle. And this is exactly what professional astronomers observe (voir (The sporadic radiant and distribution of meteors in the atmosphere as observed by VHF radar at Arctic, Antarctic and equatorial latitudes, 2009)):

translation in to

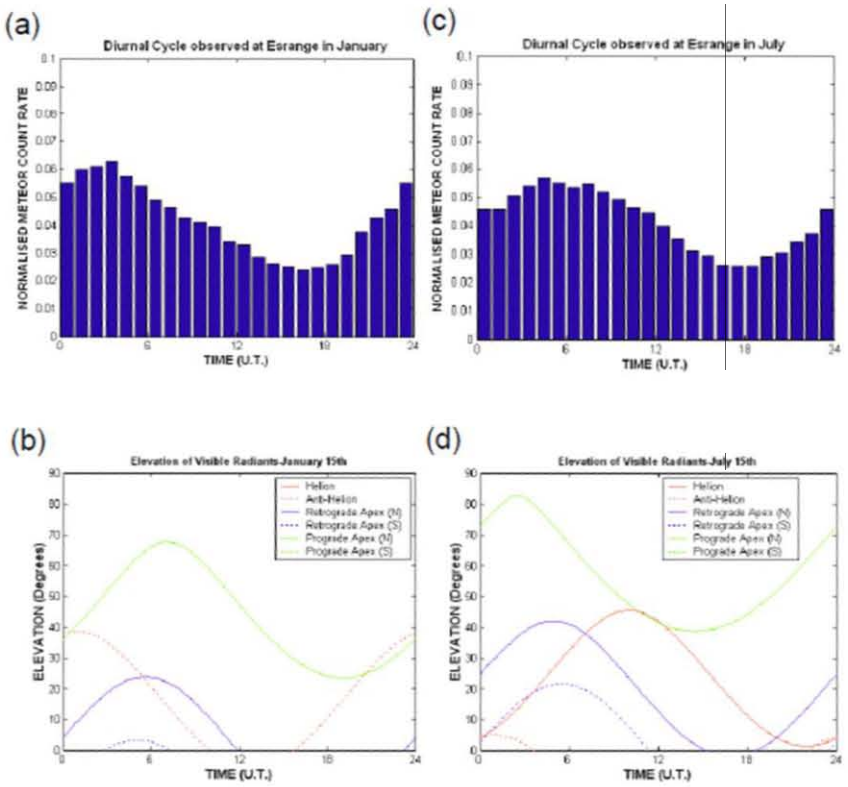
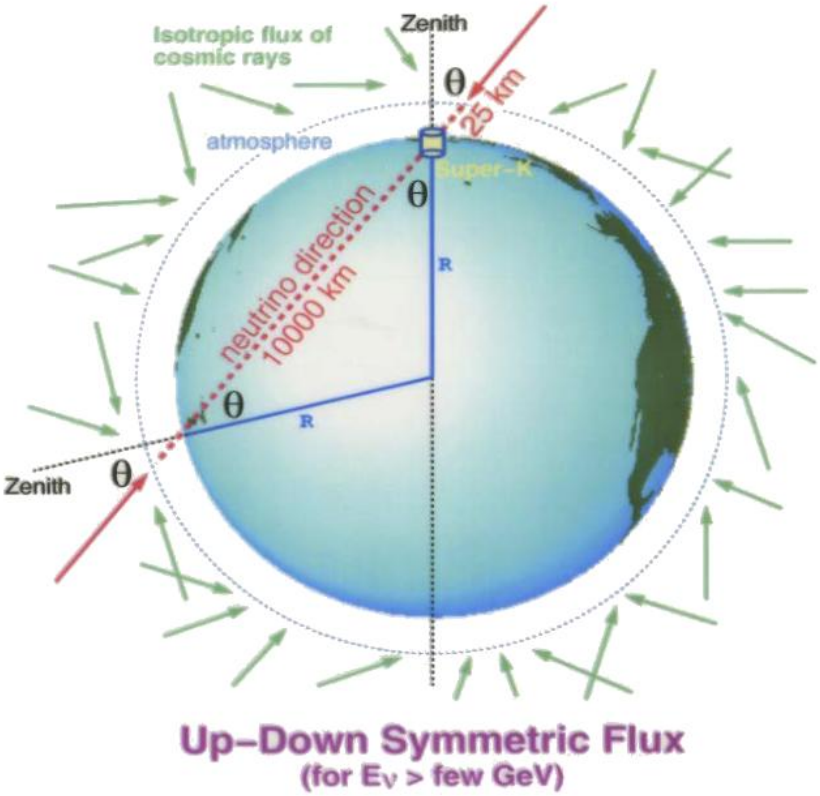


Fig. 8. Hourly meteor count rate observed at Esrange on **(a)** January 2004 and **(b)** July 2004 (Note the use of universal time). The elevation angles of the six source regions of the sporadic radiant distribution are shown in (a) for 15 January 2004 and (b) for 15 July 2004.

and the field of view of the Esrange radar were determined. These are displayed in Fig. 7 for March (red dotted line) and June/July (blue dotted line). These two periods correspond to the time of minimum and maximum meteor count rates respectively. In March the southern apex and southern prograde apex source regions are below the local horizon. Hence meteors from these source regions can not be observed at Esrange. The northern apex, helion and anti-helion sources are also close to the local horizon (within ~20°) thus lessening the sensitivity of the radar to these sources (Sect. 2). This poor viewing geometry appears responsible for the low meteor count rates observed in March. However, in June and July the helion, anti-helion, southern apex and northern sources are all above the local horizon and thus all contribute to observed count rates. As discussed in Sect. 4, and above, at this time the change in density structure of the atmosphere also results in the detection of fainter meteors than at any other time of the year. Thus, the combination of good viewing geometry and the atmospheric conditions results in the large count rates observed in the summer months. Similar arguments can be used to explain the count rate distributions at Rothera and Ascension Island.

(#204) Angular distribution of cosmic ray intensity

Cosmic rays, which are primarily charged particles, originate from sources outside our solar system. When they enter Earth's atmosphere, they interact with molecules present there, producing showers of secondary particles that reach Earth's surface.



The symmetry of the angular distribution of cosmic ray intensity with respect to the zenith is explained by the Earth's spherical shape and the homogeneity of its atmosphere. Regardless of the direction of the incident cosmic ray, the rays traverse a similar thickness of atmosphere before reaching the Earth's surface. This uniformity in the angular distribution arises from the fact that, on a sphere, all directions are equivalent when considering the distance traveled through the atmosphere.

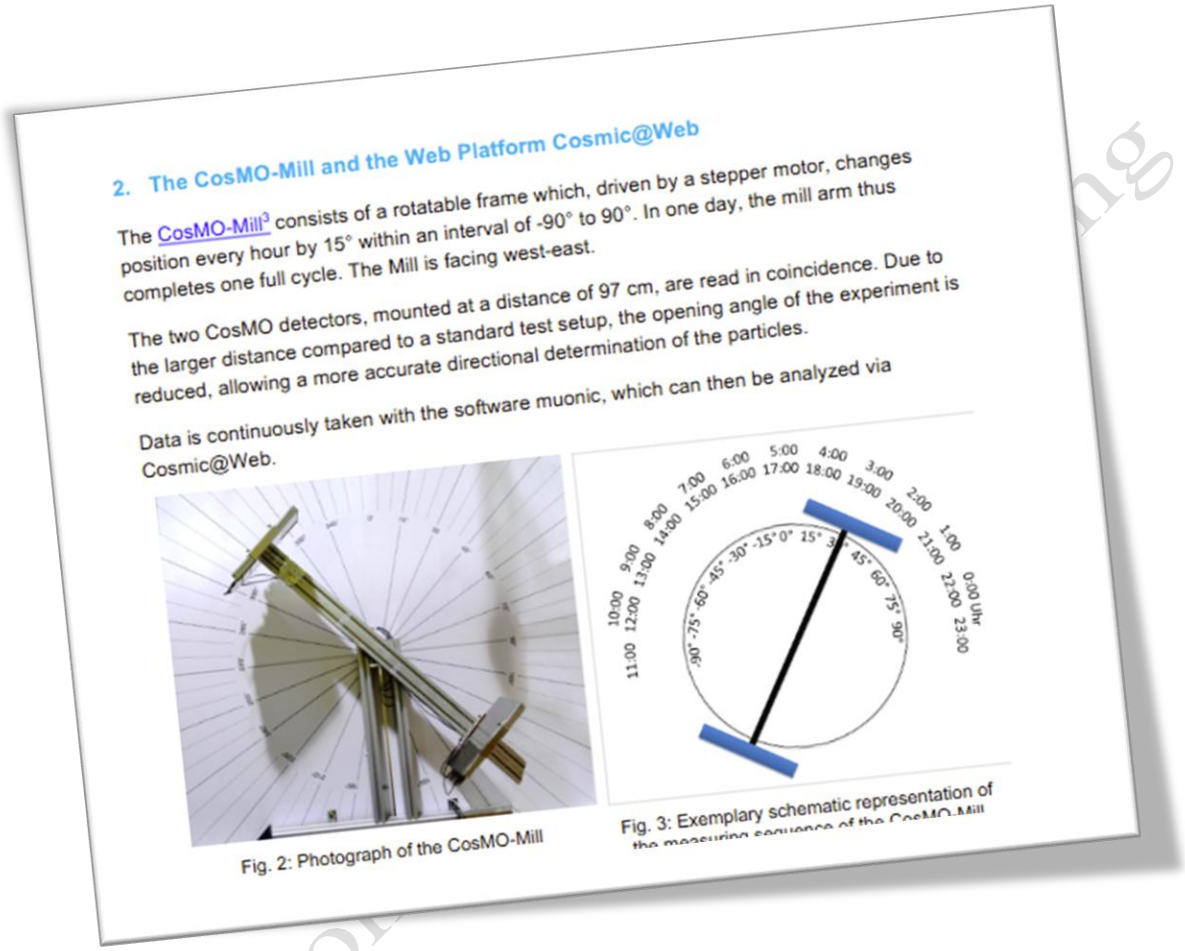
Conversely, on a flat Earth, the thickness of the atmosphere would vary depending on the angle of incidence of cosmic rays. A cosmic ray arriving perpendicularly to the surface would pass through a maximum atmospheric thickness, while a ray arriving at an oblique angle would pass through a much greater thickness, even an infinite one for very small angles relative to the horizontal. This inhomogeneity would result in an asymmetrical angular distribution of cosmic ray intensity.

The symmetry observed in the angular distribution of cosmic ray intensity relative to the zenith is therefore evidence in favor of the Earth's spherical shape. A flat Earth could not generate such symmetry due to the significant variations in the thickness of the atmosphere through which cosmic rays pass, depending on their angle of incidence.

As stated in:

https://icd.desy.de/sites/sites_conferences/site_icd/content/e171345/e171585/toggle_text171586/text171687/Untersuchung_Zenitwinkelabhngigkeit_engl_ICD20.pdf

On page 2, the experiment can be reproduced for just a few hundred euros with simple equipment of a college school level:



2. The CosMO-Mill and the Web Platform Cosmic@Web

The CosMO-Mill[3] consists of a rotatable frame which, driven by a stepper motor, changes position every hour by 15° within an interval of -90° to 90°. In one day, the mill arm thus completes one full cycle. The Mill is facing west-east.

The two CosMO detectors, mounted at a distance of 97 cm, are read in coincidence. Due to the larger distance compared to a standard test setup, the opening angle of the experiment is reduced, allowing a more accurate directional determination of the particles.

Data is continuously taken with the software muonic, which can then be analyzed via Cosmic@Web.

Fig. 2: Photograph of the CosMO-Mill

Fig. 3: Exemplary schematic representation of

This results in a muon concentration that is symmetrical with respect to the vertical axis:

translation

3. Evaluation of data with Cosmic@Web

Cosmic@Web offers its users two modes that allow different settings. The *Standard* mode makes it easy and fast to get started, with settings reduced to only the essentials (alongside a helpful tutorial to explain the features). In the *Detailed* mode, the analysis of the data can be refined, and the presentation of the diagram can be adapted to your own requirements.

3.1. Muon rate as a function of angle

In order to investigate the dependence of the muon rate on the selected measurement angle, it makes sense to use an xy-diagram. The following settings will lead to a suitable diagram of a measurement between the 9th and the 18th May 2016:

Dataset: 2016_M – rate per angle
Plot Type: xy-Plot
x-Variable: angle [deg]
y-Variable: mu_rate [1/h]
Condition: 2016050900 <= ymdh <= 2016051823
Symbol Size: 10

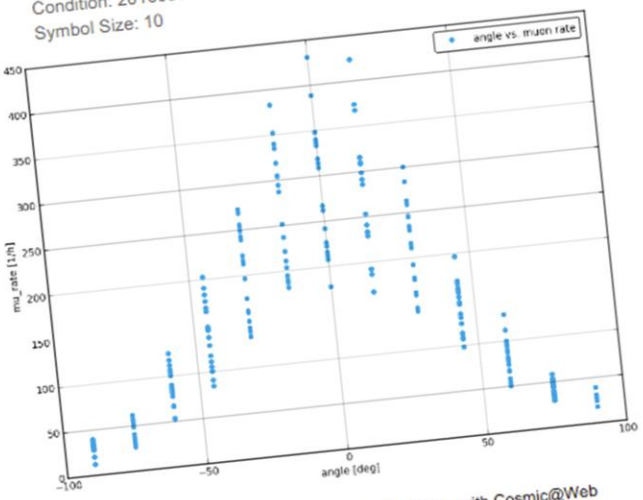


Fig. 4: Investigation of the zenith angle dependence with Cosmic@Web

It can be clearly seen that the highest rates were measured at zenith, and that the particle rate continuously decreases as the zenith angle increases. An increased dispersion of the measured values in the muon rate is also observed at smaller zenith angles.

Due to the scaling of the y-axis, this scattering is more clearly visible at measuring angles of 0°, and less visible at measuring angles of 90° or -90°. Thus, the values at 0° vary from 175 to 440 particles per hour, at -45° from 80 to 200 particles per hour. However, the deviation

3

This is consistent with a spherical Earth but incompatible with a flat Earth!

Standards Reference Documents/Technical Documents

Numerous technical and regulatory documents from various fields in civil engineering, avionics, geology, etc., require or recommend taking into account the Earth's curvature or its spherical shape. We will examine some of these below, with a screenshot of each original document!

tra

(#205) National Society of Professional Surveyors (NSPS) convention

The National Society of Professional Surveyors (NSPS) requires that geomatics practitioners in the United States take into account an average declination of 8 cm per kilometer (see the book (Definitions of Surveying and Associated Terms, 2005)). This is simply because the Earth is obviously not flat!

:urvature of field—An aberration affecting the longitudinal position of images off the axis in such a manner that objects in a)lane perpendicular to the axis are imaged in a curved or dish-shaped surface. See also ***aberration of light*** (definition **2).**

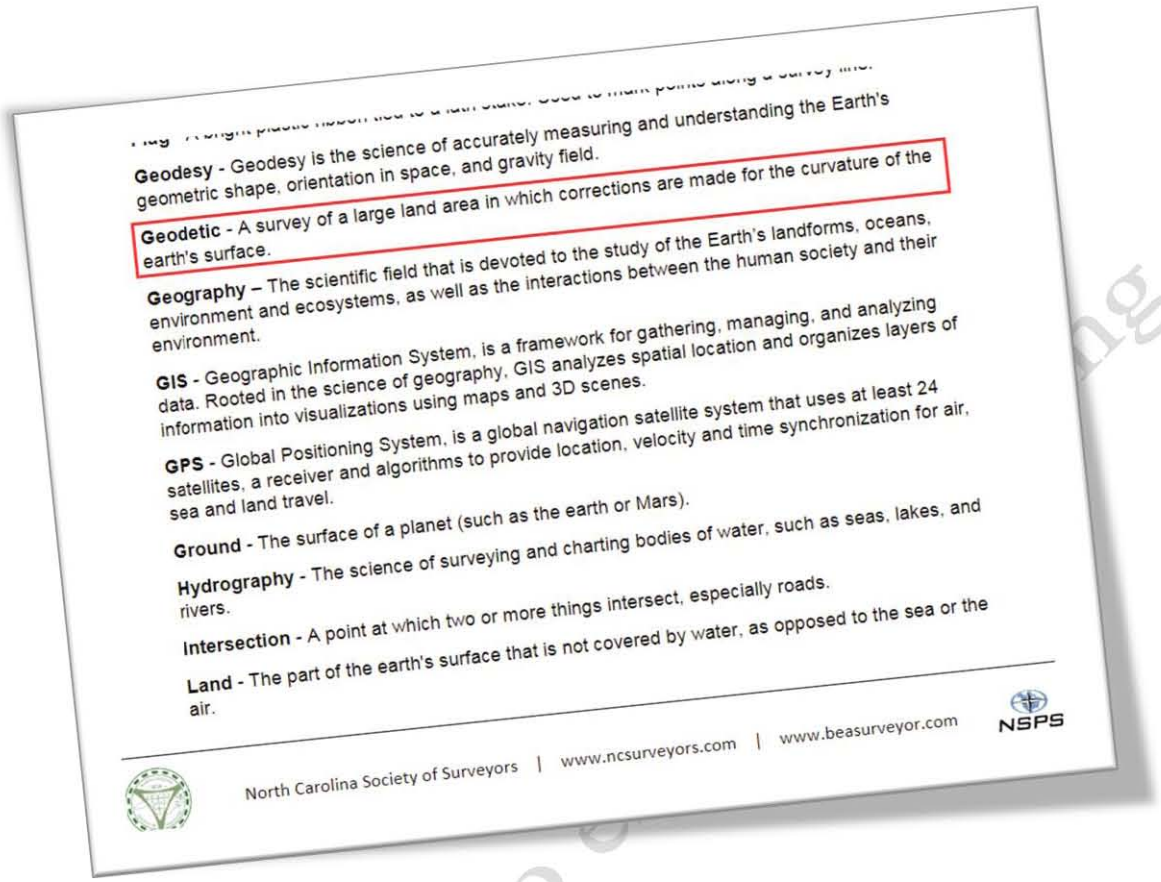
:urvature of the Earth, correction for [SURVEYING]-[1] That offset from the tangent to the curve resulting from curvature of he Earth. The offset amounts to about 8 cm at 1 km distance.[2] That offset which is given in surveying tables as correction or curvature of the Earth. The values given in such tables usually combine the effects of both curvature the Earth and tmospheric refraction. Under normal conditions, the atmospheric refraction compensates partially for the curvature of the :arth, so the correction is about 6 cm for a point 1 km away.

Source: NSPS "**Definitions of Surveying and Related Terms**", used with permission.

Figure 121 Illustration of surveyors/topographers with their cave dweller

Or in their document available here on page 1:

https://www.ncsurveyors.com/files/PDFs/Definitions_Word_Search.pdf



Geodesy - Geodesy is the science of accurately measuring and understanding the Earth's geometric shape, orientation in space, and gravity field.

Geodetic - A survey of a large land area in which corrections are made for the curvature of the earth's surface.

Geography – The scientific field that is devoted to the study of the Earth's landforms, oceans, environment and ecosystems, as well as the interactions between the human society and their environment.

GIS - Geographic Information System, is a framework for gathering, managing, and analyzing data. Rooted in the science of geography, GIS analyzes spatial location and organizes layers of information into visualizations using maps and 3D scenes.

GPS - Global Positioning System, is a global navigation satellite system that uses at least 24 satellites, a receiver and algorithms to provide location, velocity and time synchronization for air, sea and land travel.

Ground - The surface of a planet (such as the earth or Mars).

Hydrography - The science of surveying and charting bodies of water, such as seas, lakes, and rivers.

Intersection - A point at which two or more things intersect, especially roads.

Land - The part of the earth's surface that is not covered by water, as opposed to the sea or the air.

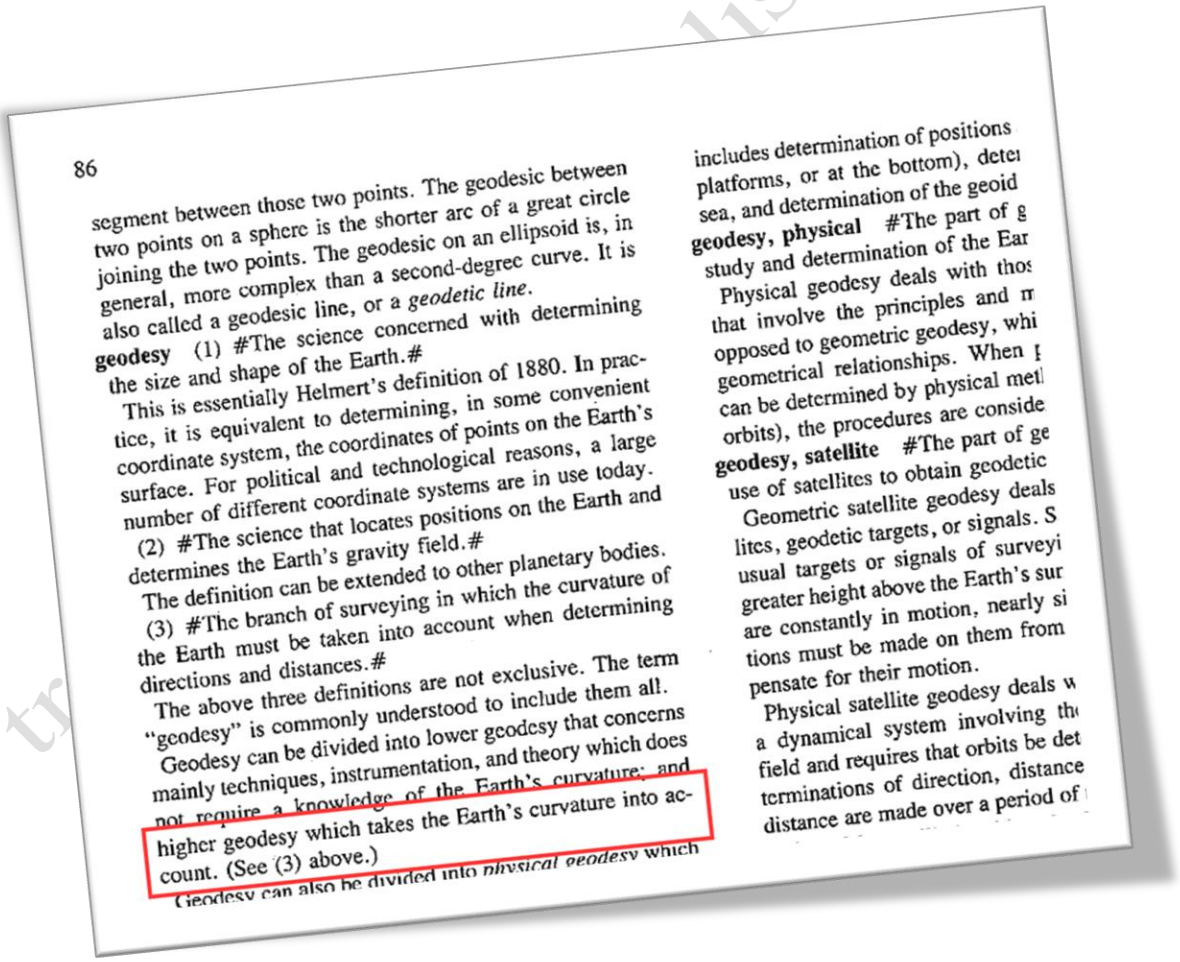
North Carolina Society of Surveyors | www.ncsurveyors.com | www.beasurveyor.com NSPS

translation into

(#206) NOAA (National Oceanic and Atmospheric Administration) Glossary

They also mention the fact that higher geodesy requires taking into account Earth's curvature:

https://repository.library.noaa.gov/view/noaa/2827/noaa_2827_DS1.pdf



86

segment between those two points. The geodesic between two points on a sphere is the shorter arc of a great circle joining the two points. The geodesic on an ellipsoid is, in general, more complex than a second-degree curve. It is also called a geodesic line, or a *geodetic line*.

geodesy (1) #The science concerned with determining the size and shape of the Earth.#

This is essentially Helmert's definition of 1880. In practice, it is equivalent to determining, in some convenient coordinate system, the coordinates of points on the Earth's surface. For political and technological reasons, a large number of different coordinate systems are in use today.

(2) #The science that locates positions on the Earth and determines the Earth's gravity field.#

The definition can be extended to other planetary bodies.

(3) #The branch of surveying in which the curvature of the Earth must be taken into account when determining directions and distances.#

The above three definitions are not exclusive. The term "geodesy" is commonly understood to include them all.

Geodesy can be divided into lower geodesy that concerns mainly techniques, instrumentation, and theory which does not require a knowledge of the Earth's curvature; and higher geodesy which takes the Earth's curvature into account. (See (3) above.)

Geodesy can also be divided into *physical geodesy* which includes determination of positions platforms, or at the bottom), deter sea, and determination of the geoid

geodesy, physical #The part of g study and determination of the Ear

Physical geodesy deals with thos that involve the principles and m opposed to geometric geodesy, whi geometrical relationships. When p can be determined by physical met orbits), the procedures are conside

geodesy, satellite #The part of ge use of satellites to obtain geodetic

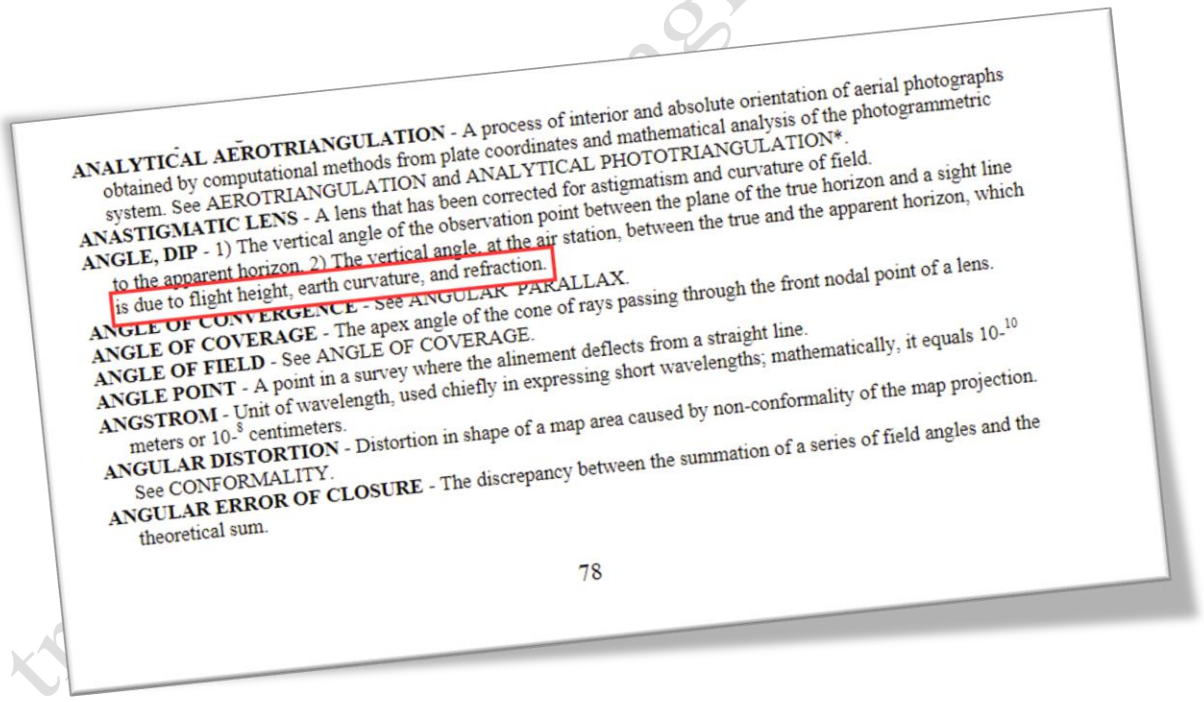
Geometric satellite geodesy deals lites, geodetic targets, or signals. S usual targets or signals of surveyi greater height above the Earth's sur are constantly in motion, nearly si tions must be made on them from pensate for their motion.

Physical satellite geodesy deals w a dynamical system involving th field and requires that orbits be det terminations of direction, distance distance are made over a period of

(#207) Glossary of the BLM (Bureau of Land Management)

The U.S. Department of the Interior's Land Management, in its official glossary available on its website, confirms that the angle between the true horizon and the line of sight is due to the curvature of the Earth and refraction.

https://www.blm.gov/sites/default/files/cadastralglossary.pdf



ANALYTICAL AEROTRIANGULATION - A process of interior and absolute orientation of aerial photographs obtained by computational methods from plate coordinates and mathematical analysis of the photogrammetric system. See AEROTRIANGULATION and ANALYTICAL PHOTOTRIANGULATION*.

ANASTIGMATIC LENS - A lens that has been corrected for astigmatism and curvature of field.

ANGLE, DIP - 1) The vertical angle of the observation point between the plane of the true horizon and a sight line to the apparent horizon. 2) The vertical angle, at the air station, between the true and the apparent horizon, which is due to flight height, earth curvature, and refraction.

ANGLE OF CONVERGENCE - See ANGULAR PARALLAX.

ANGLE OF COVERAGE - The apex angle of the cone of rays passing through the front nodal point of a lens.

ANGLE OF FIELD - See ANGLE OF COVERAGE.

ANGLE POINT - A point in a survey where the alinement deflects from a straight line.

ANGSTROM - Unit of wavelength, used chiefly in expressing short wavelengths; mathematically, it equals 10^{-10} meters or 10^{-8} centimeters.

ANGULAR DISTORTION - Distortion in shape of a map area caused by non-conformality of the map projection. See CONFORMALITY.

ANGULAR ERROR OF CLOSURE - The discrepancy between the summation of a series of field angles and the theoretical sum.

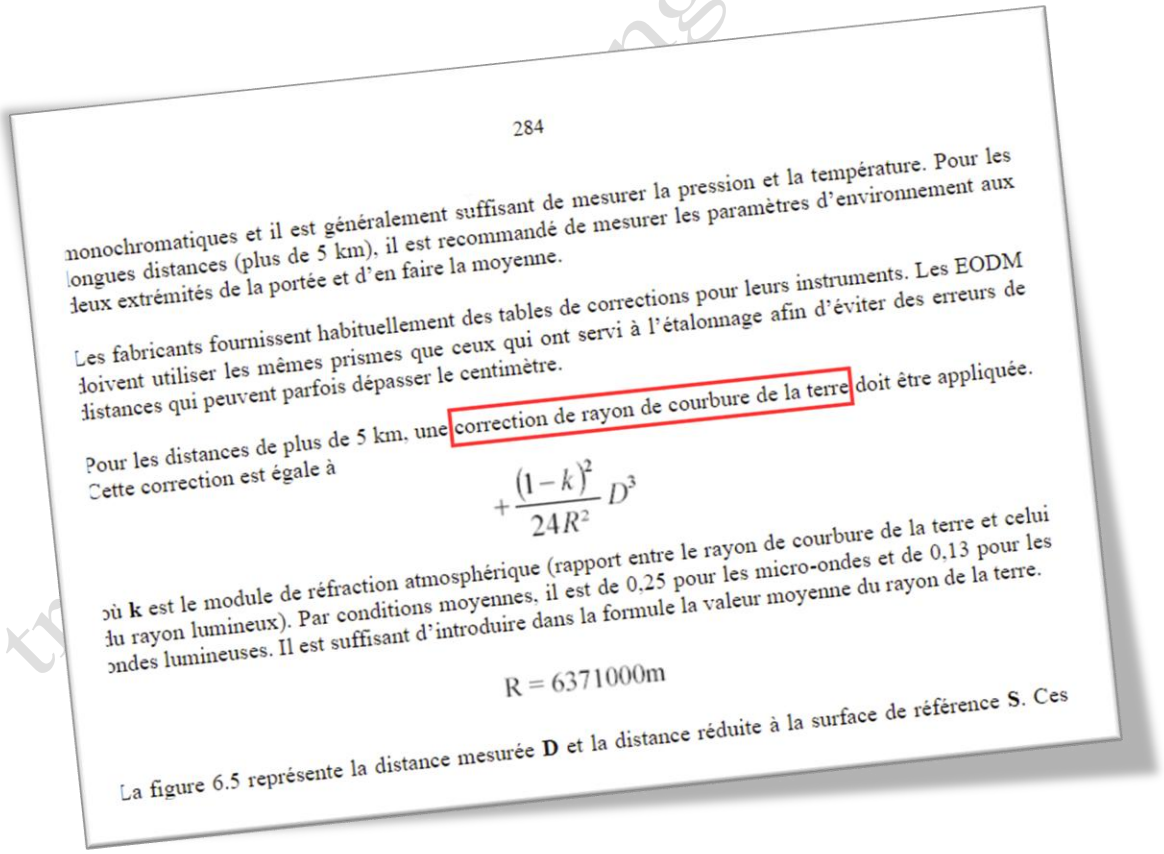
78

(#208) IHO (International Hydrographic Organization) Convention

The International Hydrographic Organization (IHO) is an intergovernmental organization that ensures that all the world's seas, oceans, and navigable waters are surveyed and charted. Founded in 1921, it coordinates the activities of national hydrographic offices and promotes the uniformity of nautical charts and documents.

The latter requires in its internal documentation the consideration of the curvature of the Earth for the simple reason that the Earth is obviously not flat!

https://iho.int/uploads/user/pubs/cb/c-13/french/C-13_e1.0.0_FR_Ch6.pdf



284

nonochromatiques et il est généralement suffisant de mesurer la pression et la température. Pour les longues distances (plus de 5 km), il est recommandé de mesurer les paramètres d'environnement aux deux extrémités de la portée et d'en faire la moyenne.

Les fabricants fournissent habituellement des tables de corrections pour leurs instruments. Les EODM doivent utiliser les mêmes prismes que ceux qui ont servi à l'étalonnage afin d'éviter des erreurs de distances qui peuvent parfois dépasser le centimètre.

Pour les distances de plus de 5 km, une correction de rayon de courbure de la terre doit être appliquée. Cette correction est égale à

$$+\frac{(1-k)^2}{24R^2}D^3$$

où **k** est le module de réfraction atmosphérique (rapport entre le rayon de courbure de la terre et celui du rayon lumineux). Par conditions moyennes, il est de 0,25 pour les micro-ondes et de 0,13 pour les ondes lumineuses. Il est suffisant d'introduire dans la formule la valeur moyenne du rayon de la terre.

$$R = 6371000m$$

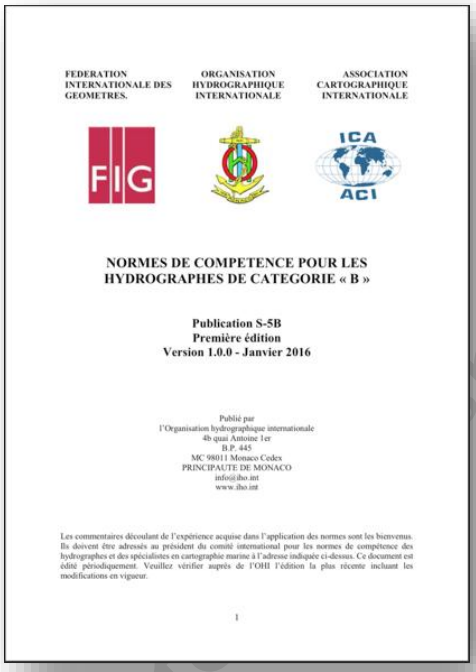
La figure 6.5 représente la distance mesurée **D** et la distance réduite à la surface de référence **S**. Ces

For the people that don't speak French here is the translation of the part of interest: "*For distances over 5 km, a correction for the radius of curvature of the Earth must be applied.*"

(#209) FIG (International Federation of Surveyors) Standards

The International Federation of Surveyors (FIG), in collaboration with the International Hydrographic Organization (IHO) and the International Cartographic Association (ICA), in its *Standard of Competence for Category B Hydrographers* (in french: *Norme de compétences pour les hydrographes de Catégorie B*):

https://iho.int/iho_pubs/standard/S-5/S-5B-Ed1.0.0_F.pdf



FEDERATION INTERNATIONALE DES GEOMETRES.

ORGANISATION HYDROGRAPHIQUE INTERNATIONALE

ASSOCIATION CARTOGRAPHIQUE INTERNATIONALE

NORMES DE COMPETENCE POUR LES HYDROGRAPHES DE CATEGORIE « B »

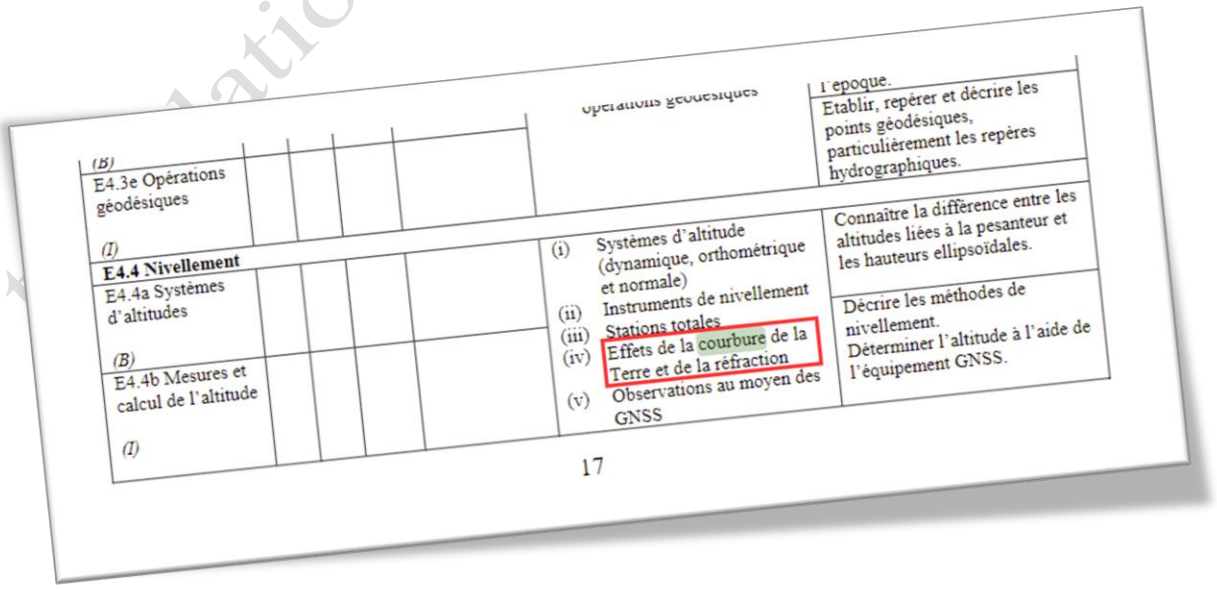
Publication S-5B
Première édition
Version 1.0.0 - Janvier 2016

Publié par
l'Organisation hydrographique internationale
4b quai Antoine 1er
B.P. 445
MC 98011 Monaco Cedex
PRINCIPAUTE DE MONACO
info@iho.int
www.iho.int

Les commentaires découlant de l'expérience acquise dans l'application des normes sont les bienvenus. Ils doivent être adressés au président du comité international pour les normes de compétence des hydrographes et des spécialistes en cartographie marine à l'adresse indiquée ci-dessus. Ce document est édité périodiquement. Veuillez vérifier auprès de l'OHI l'édition la plus récente incluant les modifications en vigueur.

1

they confirm that the curvature of the Earth and refraction must be taken into account for altitude measurements for the simple reason that the Earth is obviously not flat!



				opérations géodésiques	l'époque.
(B) E4.3e Opérations géodésiques (I)					Etablir, repérer et décrire les points géodésiques, particulièrement les repères hydrographiques.
E4.4 Nivellement					
E4.4a Systèmes d'altitudes				(i) Systèmes d'altitude (dynamique, orthométrique et normale)	Connaître la différence entre les altitudes liées à la pesanteur et les hauteurs ellipsoïdales.
(B) E4.4b Mesures et calcul de l'altitude (I)				(ii) Instruments de nivellement (iii) Stations totales (iv) Effets de la courbure de la Terre et de la réfraction (v) Observations au moyen des GNSS	Décrire les méthodes de nivellement. Déterminer l'altitude à l'aide de l'équipement GNSS.

17

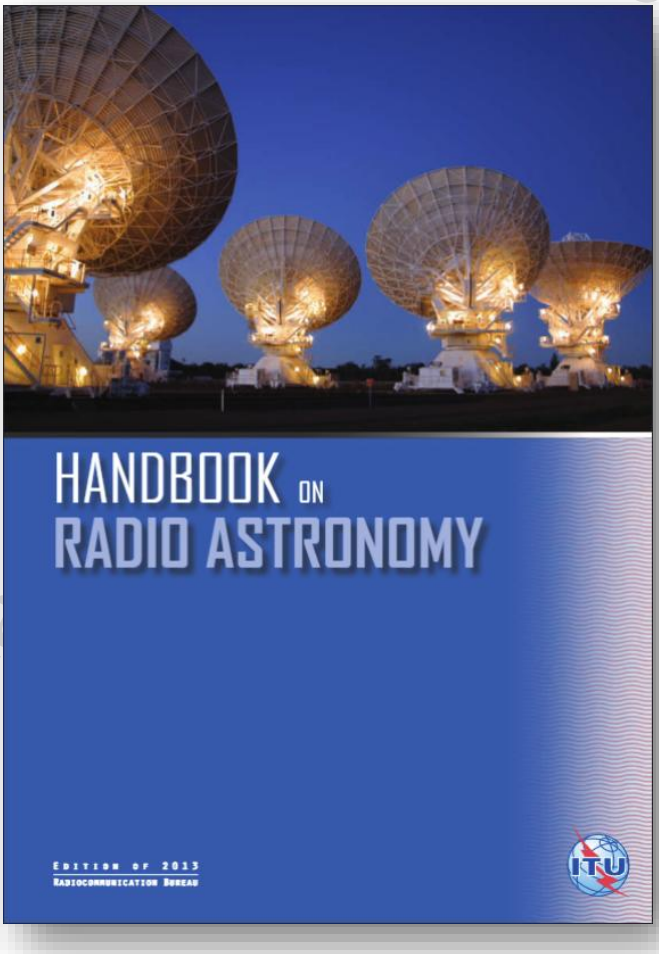
For the non-French speakers it is written for information: "*Effects of Earth's curvature and of refraction*"

translation into english ongoing

(#210) International Telecommunication Union

The International Telecommunication Union (ITU) confirms in its Radio Astronomy Manual, freely available on its website in french:

https://www.itu.int/dms_pub/itu-r/opb/hdb/R-HDB-22-2013-PDF-E.pdf



that the Earth does indeed have a curvature:

CHAPTER 5

Sharing the radio astronomy bands with other services

5.1 General remarks

Most radio astronomy bands are shared with active services, which transmit. Such sharing is particularly difficult for radio astronomy, which is a passive service and is very sensitive to interference. Because of the great distances of astronomical sources, the pfd levels of the emissions under investigation are often 100 dB or more below those of man-made transmissions near the radio observatory. The strength and characteristics of the astronomical signals are determined by laws of nature and are beyond the control of the radio astronomer. Furthermore, because of the experimental nature of the science the radio astronomer is often unable to know in advance what the characteristics of the emissions will be. These factors make radio astronomy particularly vulnerable to interference. Interference can be damaging not only if it is strong and obliterates the astronomical signals, but also if it is weak. An insidious danger to radio astronomy lies in the interference which is just below the power level at which it can be recognized in individual measurements, and which is present for a large fraction of the total time. In this case there may be no means during the experiment of detecting that interference has occurred, and the subsequent results could contain serious errors.

Radio astronomy observatories are usually located at sites specially chosen to minimize interference from other services. The sites are usually at a considerable distance from the major terrestrial sources of interference and, when not observing at mm-wavelengths, where it is important to get above as much of the atmosphere as possible, are frequently screened by nearby high ground. With this protection for the observatory, and the protection afforded by the curvature of the Earth, sharing with terrestrial transmitters is possible when the transmitter power is low and there is sufficient geographical separation. However, with the very sensitive systems used in radio astronomy, large separations are usually necessary. It is shown in § 5.3 that sharing is not generally possible when the transmitter is within LoS of the radio astronomy antenna or the antenna feed. It is usually necessary for the transmitter to lie well over the horizon, at distances of 100 km or more. Transmitters carried in aircraft, spacecraft, high altitude platform stations or balloons can remain within LoS of an observatory for very great distances, and the advantages associated with a carefully selected observatory site and attenuation due to curvature of the Earth are both lost. At HF (3-30 MHz) any interference received is almost invariably propagated via the ionosphere. In this case, the selection of the observatory site and the curvature of the Earth do not provide protection, and in some circumstances interference can be expected from a co-channel transmitter anywhere on the Earth.

A useful distinction can be drawn between local, regional and global sharing problems. A local problem such as interference caused by a transmitter near a radio observatory will need to be solved at a local level, taking factors such as site shielding into account. Regional problems, such as the interference caused by television transmitters, have to be addressed on a regional scale, taking into account national frequency plans and other regional factors; for example the different conditions and frequency assignments in countries that are geographically close together. Global problems such as the interference caused by satellite-borne transmitters can only be solved at the ITU level. Each class of sharing problem requires its own type of solution.

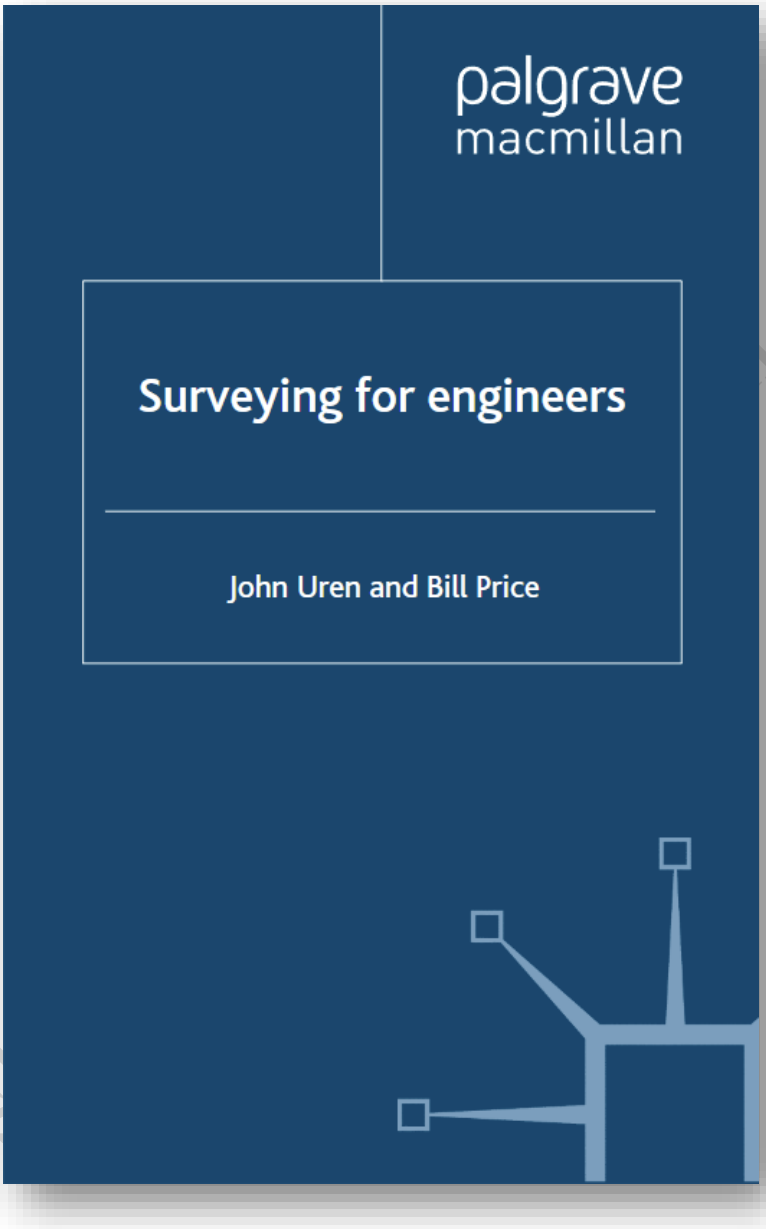
5.1.1 Protection criteria for the RAS

An important protection criterion for radio astronomy is the power level of the interference considered harmful. The harmful threshold depends on the frequency of observation and the type of measurement being made, as discussed in Chapter 4. The detailed characteristics of the interference may also need to be taken into account.

A second criterion relates to the fraction of the sky over which radio astronomy observations are to be protected. For ground-based sources of interference a value of 0 dBi is adopted for the gain of the radio astronomy antenna in the direction of the interfering source, or in the direction of the horizon for a distant transmitter. The adoption of this value means that potential sources of interference at the harmful threshold

(#211) Surveying for Engineers

In the world reference textbook *Surveying for Engineers* (5th edition), 817 pages, published by Palgrave Macmillan, by John Uren and Bill Price, ISBN 978-0-230-22157-4:



On page 56 we have the details on how curvature must be taken into account when surveyors are conducting field surveys:

The effects of curvature and refraction on levelling

In Section 2.1 it was shown that when a level is set up, it defines a horizontal line for measurement of height differences. In Figure 2.23 a level is shown set up at point A and it can be seen that the level and horizontal lines through the instrument diverge because level lines follow the curvature of the Earth which is defined as mean sea level. If not accounted for, this is a possible source of error in levelling since all readings taken at A are observed along the horizontal line instead of the level line.

However, for most levelling applications, sighting distances are relatively short and the curvature correction for a length of sight of 50 m is less than 1 mm. Consequently, when levelling, the difference between a horizontal line and a level line is small enough to be ignored.

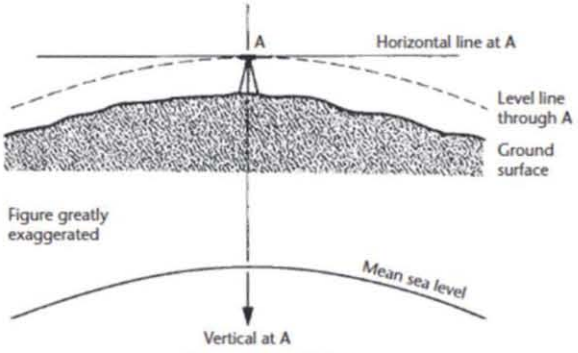
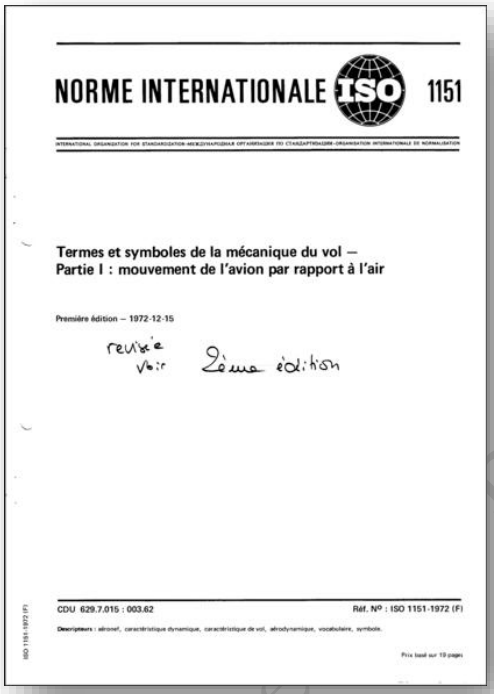


Figure 2.23 • Curvature.

(#212) International standard ISO 1151 / Flight Mechanics

The International Standard ISO 1151 *Terms and symbols for flight mechanics – Part 1: Motion of aircraft with respect to the air*:



NORME INTERNATIONALE ISO 1151

Termes et symboles de la mécanique du vol —
Partie I : mouvement de l'avion par rapport à l'air

Première édition — 1972-12-15

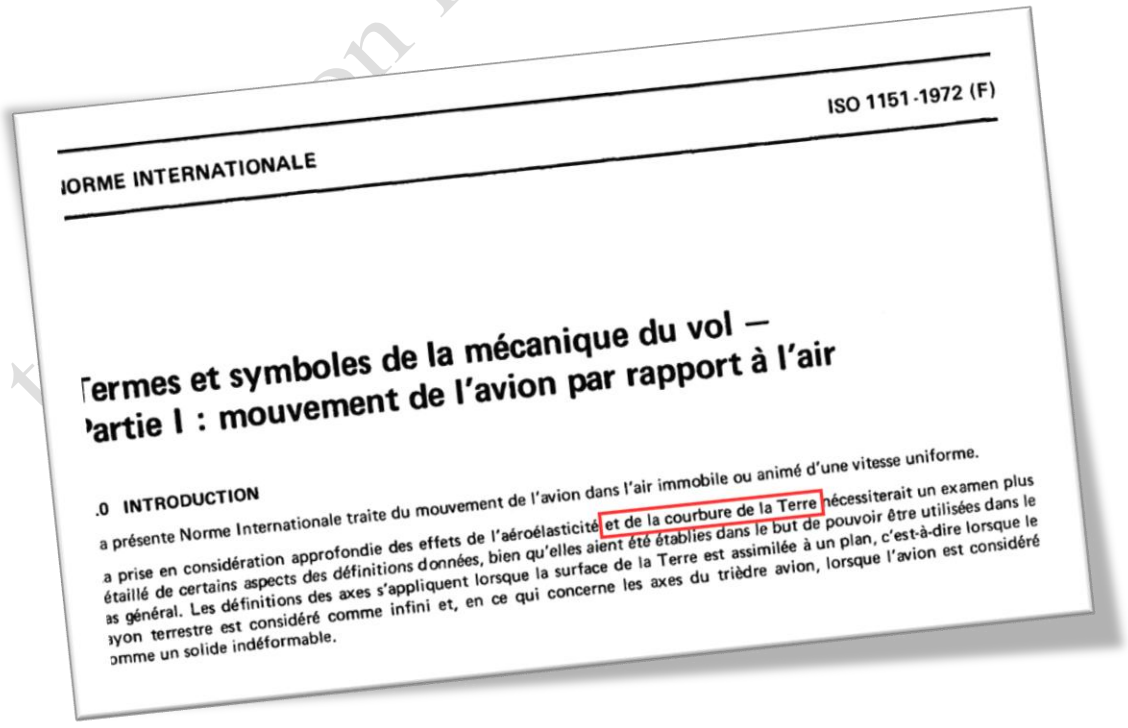
revisée
voir 2ème édition

CDU 629.7.015 : 003.62 Réf. N° : ISO 1151-1972 (F)

Descripteurs : aéronef, caractéristique dynamique, caractéristique de vol, aérodynamique, vocabulaire, symbole.

Prix basé sur 19 pages

Clearly indicates that the curvature of the Earth is a fact:



NORME INTERNATIONALE ISO 1151-1972 (F)

Termes et symboles de la mécanique du vol —
Partie I : mouvement de l'avion par rapport à l'air

0 INTRODUCTION

La présente Norme Internationale traite du mouvement de l'avion dans l'air immobile ou animé d'une vitesse uniforme.

La prise en considération approfondie des effets de l'aéroélasticité et de la courbure de la Terre nécessiterait un examen plus étaillé de certains aspects des définitions données, bien qu'elles aient été établies dans le but de pouvoir être utilisées dans le as général. Les définitions des axes s'appliquent lorsque la surface de la Terre est assimilée à un plan, c'est-à-dire lorsque le ayon terrestre est considéré comme infini et, en ce qui concerne les axes du trièdre avion, lorsque l'avion est considéré omme un solide indéformable.

For the people that don't speak French here is the translation of the part of interest: "*A thorough consideration of the effects of aeroelasticity and the curvature of the Earth would require a more detailed examination of certain aspects of the given definitions, although they were established with the aim of being usable in the general case.*"

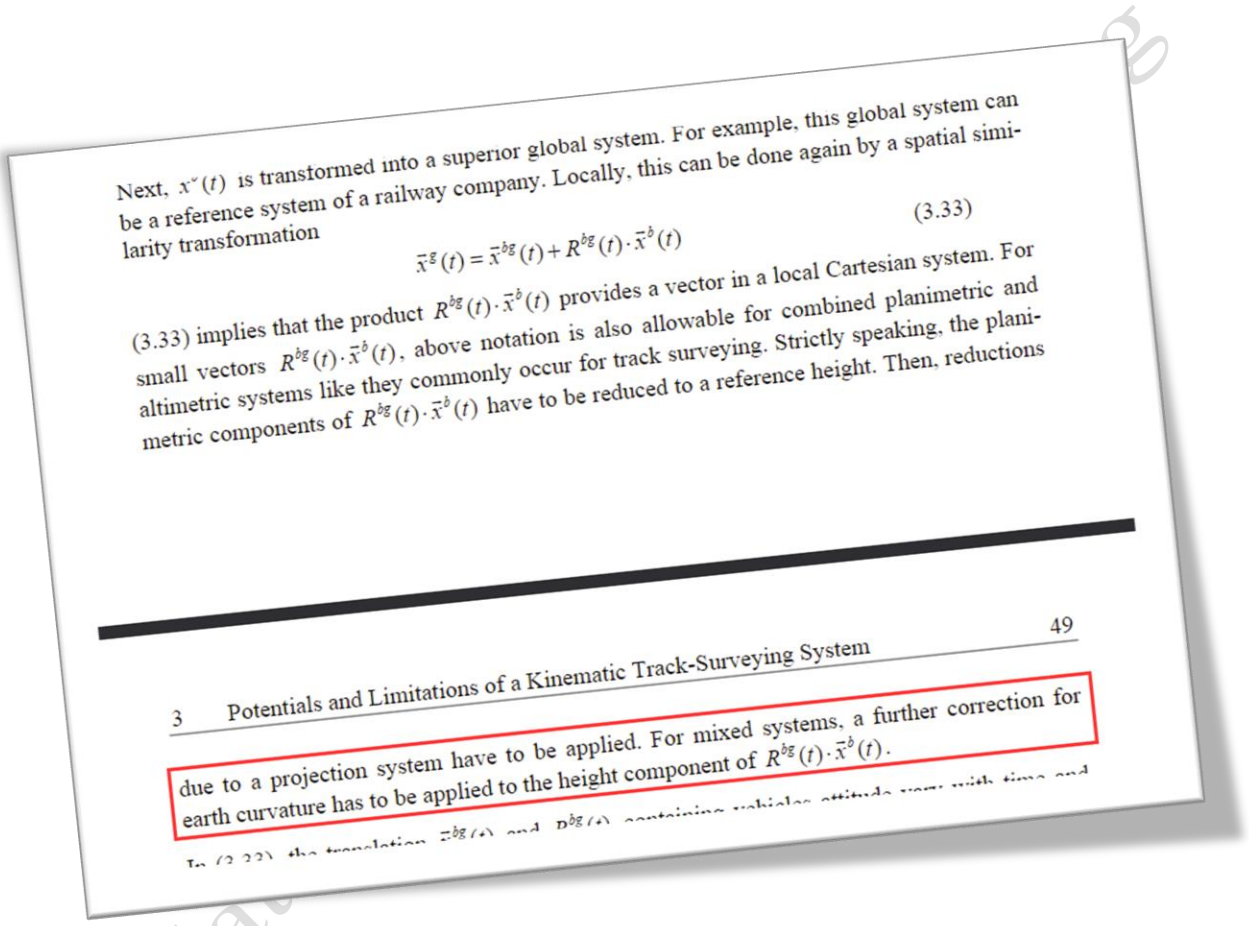
translation into english ongoing

(#213) Swiss Commission for Geodesy

In its volume number 70, available online here on the website of the Swiss Federal Institute of Technology Zurich (the school where Albert Einstein completed part of his studies):

https://www.sgc.ethz.ch/sgc-volumes/sgk-70.pdf

The Swiss Geodesy Commission clearly states that a correction must be taken into account in distance calculations to account for the curvature of the Earth:



Next, $x^r(t)$ is transformed into a superior global system. For example, this global system can be a reference system of a railway company. Locally, this can be done again by a spatial similarity transformation

$$\vec{x}^g(t) = \vec{x}^{bg}(t) + R^{bg}(t) \cdot \vec{x}^b(t) \qquad (3.33)$$

(3.33) implies that the product $R^{bg}(t) \cdot \vec{x}^b(t)$ provides a vector in a local Cartesian system. For small vectors $R^{bg}(t) \cdot \vec{x}^b(t)$, above notation is also allowable for combined planimetric and altimetric systems like they commonly occur for track surveying. Strictly speaking, the planimetric components of $R^{bg}(t) \cdot \vec{x}^b(t)$ have to be reduced to a reference height. Then, reductions

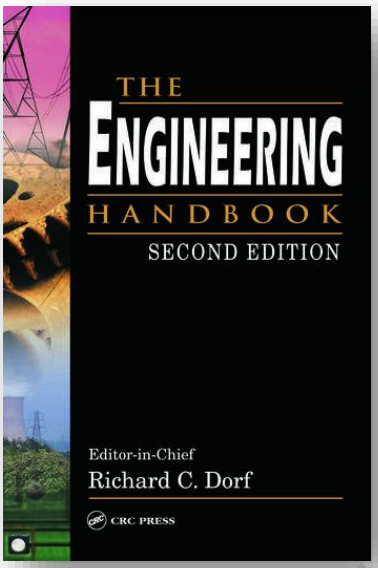
3 Potentials and Limitations of a Kinematic Track-Surveying System 49

due to a projection system have to be applied. For mixed systems, a further correction for earth curvature has to be applied to the height component of $R^{bg}(t) \cdot \vec{x}^b(t)$.

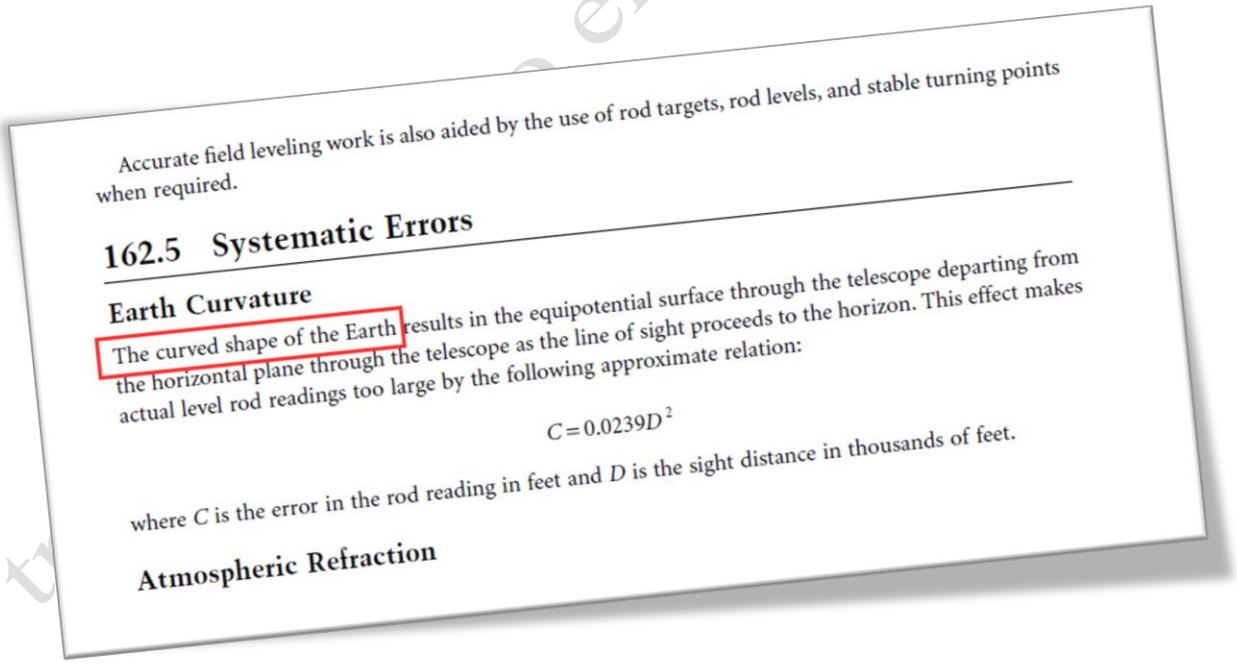
translation

(#214) The Engineering Handbook

The *Engineering Handbook* (a global reference for engineers worldwide) of 2,888 pages:



Clearly states on page 2092 that the curvature of the Earth must be taken into account:



Accurate field leveling work is also aided by the use of rod targets, rod levels, and stable turning points when required.

162.5 Systematic Errors

Earth Curvature

The curved shape of the Earth results in the equipotential surface through the telescope departing from the horizontal plane through the telescope as the line of sight proceeds to the horizon. This effect makes actual level rod readings too large by the following approximate relation:

$$C = 0.0239D^2$$

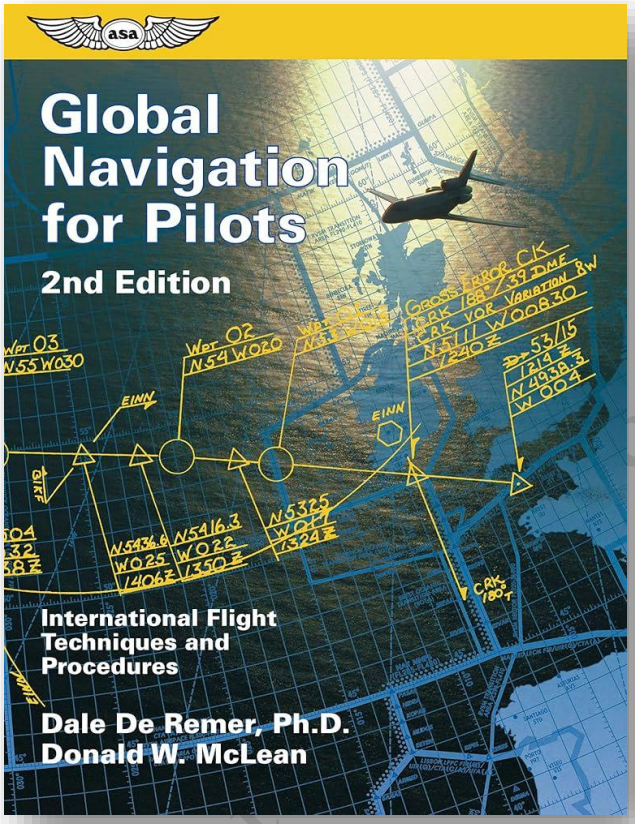
where C is the error in the rod reading in feet and D is the sight distance in thousands of feet.

Atmospheric Refraction

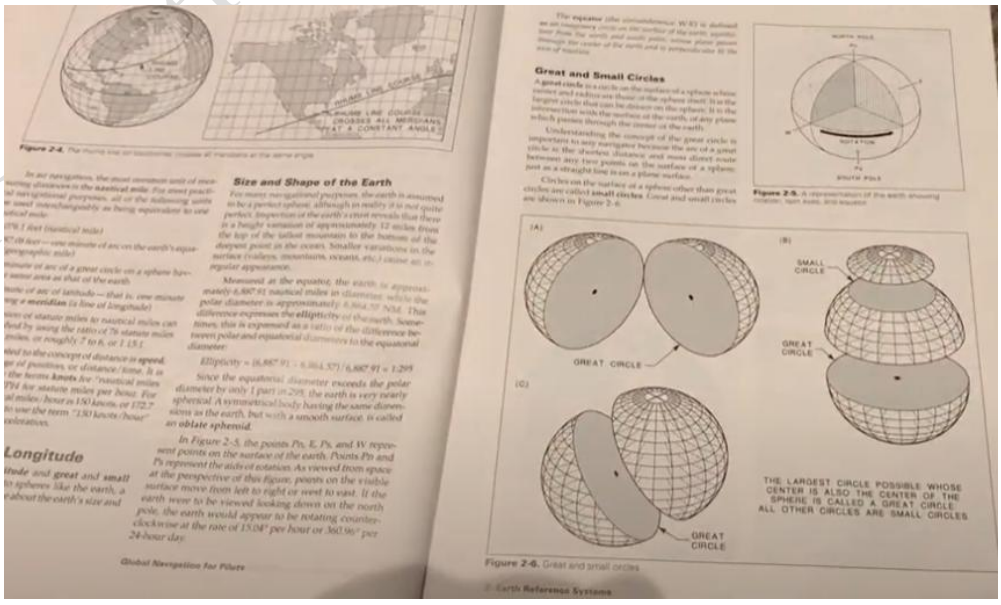
translate english ongoing

(#215) Techniques and Procedures for International Flights

From the world reference book for international flight pilots published by Aviation Supplies and Academics:



On page 441, by PhD Dale de Remer and Gary M. Ullrich, published (1997) by Aviation Supplies & Academics Newcastle, Washington (USA), we have the Earth that is illustrated many times in spherical form:


Size and Shape of the Earth
Great and Small Circles
Longitude
GREAT CIRCLE
SMALL CIRCLE
THE LARGEST CIRCLE POSSIBLE WHOSE CENTER IS ALSO THE CENTER OF THE SPHERE IS CALLED A GREAT CIRCLE. ALL OTHER CIRCLES ARE SMALL CIRCLES

traduction in progress ongoing

And this is far from being the only book:

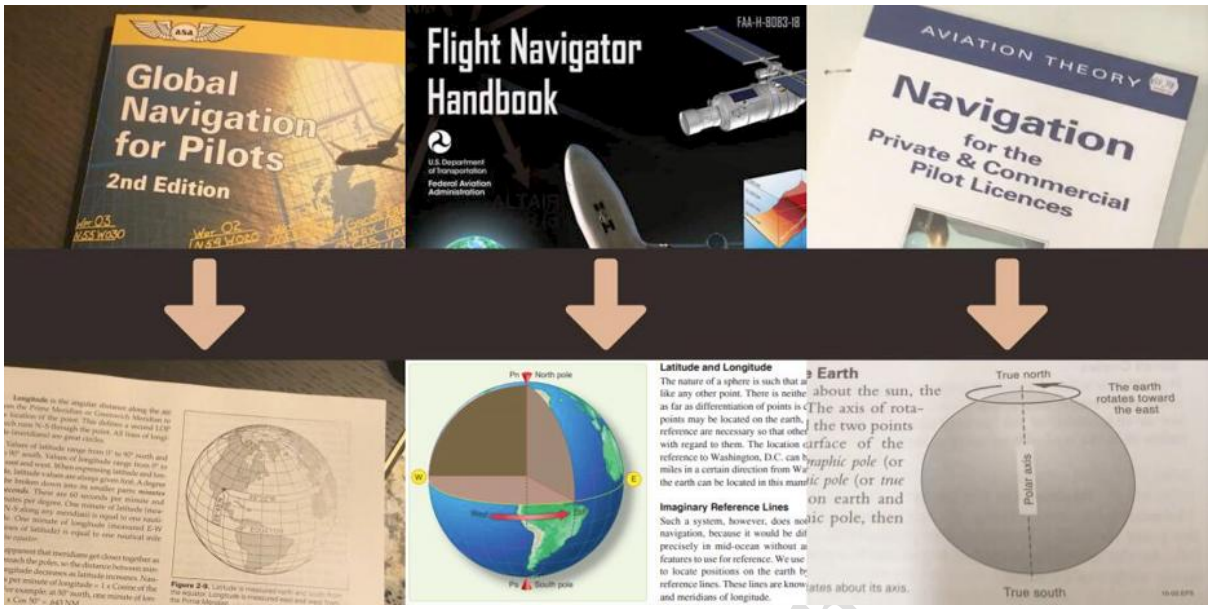


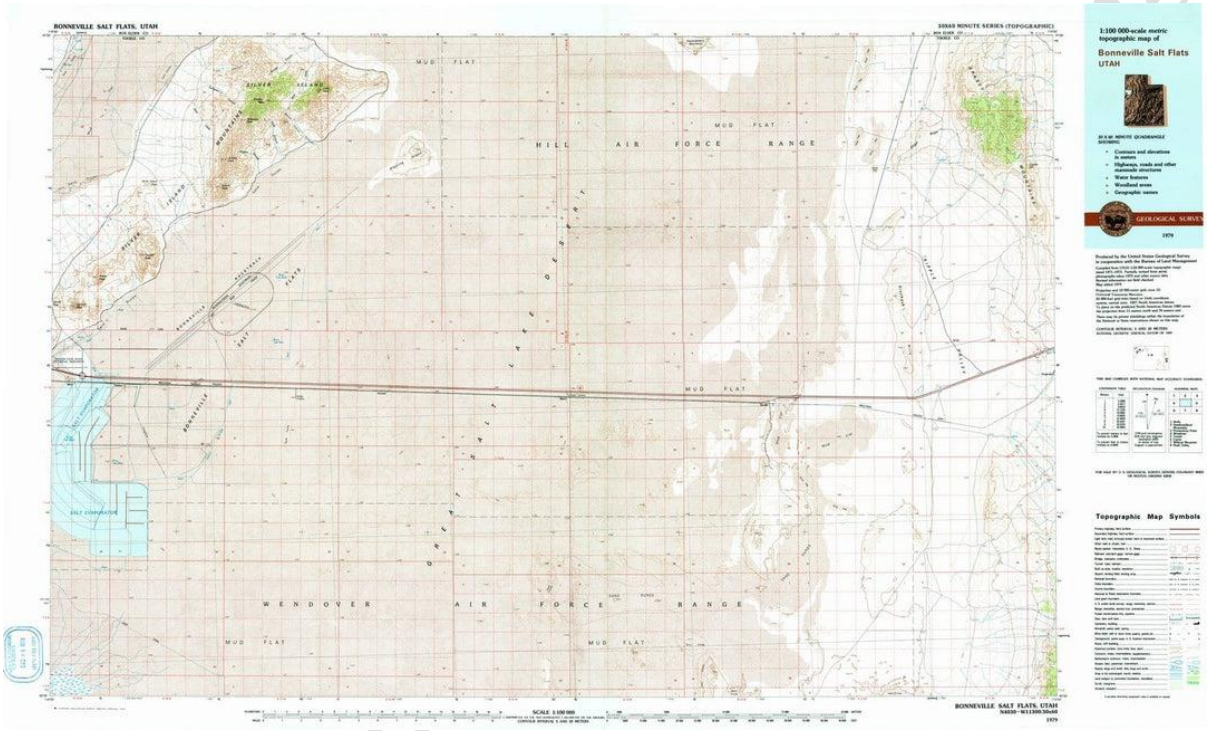
Figure 122 Some books for professional pilots that refer to a spherical Earth (credit: Wolfie6020)

translation into english

(#216) Territorial paving (PLSS)

The United States Public Lands Survey System[8] (PLSS) was established shortly after the Revolutionary War to describe and record parcels of land for legal purposes.

In this system, the lands are divided into parcels called "townships," which are typically 6 miles on each side and contain 36 sections. Each section is approximately 1 square mile (1.60934 square kilometers) and contains 640 acres (2.58999 square kilometers). Because the Earth is roughly spherical, when you try to cover the surface of a sphere with squares, they don't align perfectly:



This means that, from time to time, sections of the grid diverge from each other. Therefore, roads following these boundaries must make a bend every twenty-four miles (38.6243 kilometers) to compensate for the decreasing distances:

translation

[8] Also named "Cadastral Parcel Modification Document".

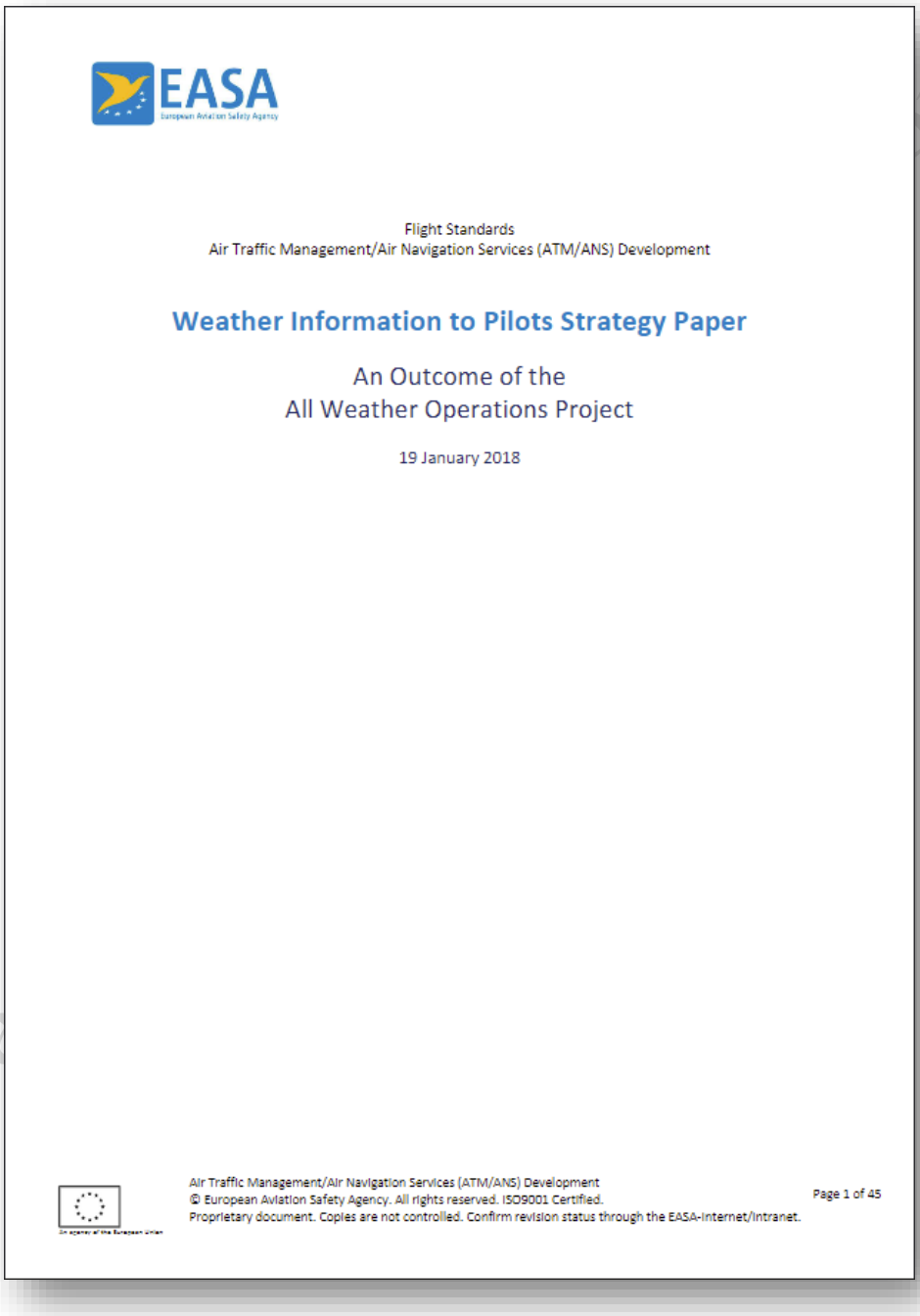
translation into english ongoing

(#217) European Aviation Safety Agency

On the EASA (European Aviation Safety Agency) website:

https://www.easa.europa.eu/sites/default/files/dfu/EASA-Weather-Information-to-Pilot-Strategy-Paper.pdf

In this document that serves as a guide for pilots:



Flight Standards
Air Traffic Management/Air Navigation Services (ATM/ANS) Development

Weather Information to Pilots Strategy Paper

An Outcome of the
All Weather Operations Project

19 January 2018

Air Traffic Management/Air Navigation Services (ATM/ANS) Development
© European Aviation Safety Agency. All rights reserved. ISO9001 Certified.
Proprietary document. Copies are not controlled. Confirm revision status through the EASA-Internet/Intranet.
Page 1 of 45

We have four times the mention of taking into account the curvature of the Earth that is specified:

- automatic tilt and automatic scan features
- Earth curvature corrections;
- independent left side / right side range settings.

Generally speaking, any feature/ functionality providing more accurate or additional pertinent weather information which can enhance the crew awareness of the weather ahead of the aircraft should be promoted. In the meantime, it is expected that increasing numbers of aircraft (new orders as well as retrofit of existing fleets) will be equipped with the latest generation of WXR as technology progresses.

8.2 Graphical representation of meteorological information

It is considered that the pilot's workload would be reduced if the information provided led directly to decisions rather than requiring interpretation and inference to make decisions. However, the processes employed (filters/colours/symbols) to derive decision support information should allow the pilot access to the underpinning meteorological information – i.e. an aerodrome may be highlighted 'red' to indicate that one or more thresholds have been exceeded, but the pilot should be able to interrogate to determine the reason for the 'red' highlight,

The Agency recommends that meteorological information should be provided, at the pre-flight briefing and in-flight updates, in a format that facilitates the:

- Display the information graphically, and in an intuitive manner
- Display of the information using appropriate colour schemes to identify, for example the severity/intensity of phenomenon
- Overlay of the information with other meteorological and/or non-meteorological information (such as the aircraft's route)
- Display information relating to validity of forecasts and the time of observations (including remotely sensed observations)
- Accessing of clear legends describing the meaning of symbols/colours/abbreviations

8.3 Meteorological information below FL 100

Currently, the provision of low-level charts for SIGWX are not required to be made available to pilots of commercial air transport operations. Under current ICAO Annex 3 requirements, the provision of a graphical low level area forecast (or low level SIGWX) is a State decision and responsibility. Under Part-MET, it is similarly a State decision and responsibility. There is no requirement to distribute low-level charts for SIGWX internationally[24]. Whilst recognising the potential utility of these products, they are not of themselves directly targeted at commercial air transport and there are a number of issues with regard to consistency of information provided, and the manner in which that data is made available.

It is also noted that work is underway (SESAR Deployment Manager (DM) with regard to the provision of pan-European high resolution data for hazardous phenomena (CAT, icing, CB cloud, winter weather), and this may be a more appropriate approach to shared situational awareness (pilot, ATS, NM) in contrast to the use of multiple sources of data in different styles and using 'static' image formats.

As noted in the 'Further considerations' section, the eGAFOR project aims to address the issues of fragmentation and inconsistency of MET products as support for low-level SIGWX. When successfully implemented, it will provide uniform information on meteorological conditions along the flight route across 8 neighbouring EU and non-EU member States. The project shall be completed by December 2020 and

[24] Note, a trial of the provision of low level area forecasts in graphical format is currently being undertaken on the Secure Aviation Data Information Service (SADIS). This will report to the ICAO EUR METG/27 meeting (September 2017), and to the Meteorological Panel's Working Group - Meteorological Operations Group (WG-MOG) provisionally in April/May 2018.

World Geodetic System WGS 84

We already covered this topic on page 400.

But as a reminder:

The World Geodetic System (WGS) is a standard used in cartography, geodesy, and satellite navigation, including GPS. The current version, WGS 84, defines a fixed, centered Earth coordinate based on a geoid system and a geodetic datum, and also describes the associated Earth Gravitational Model (EGM) and World Magnetic Model (WMM). The standard is published and maintained by the U.S. National Geospatial-Intelligence Agency.

translation into english ongoing

(#218) Garmin G1000 Nxi Navigation System

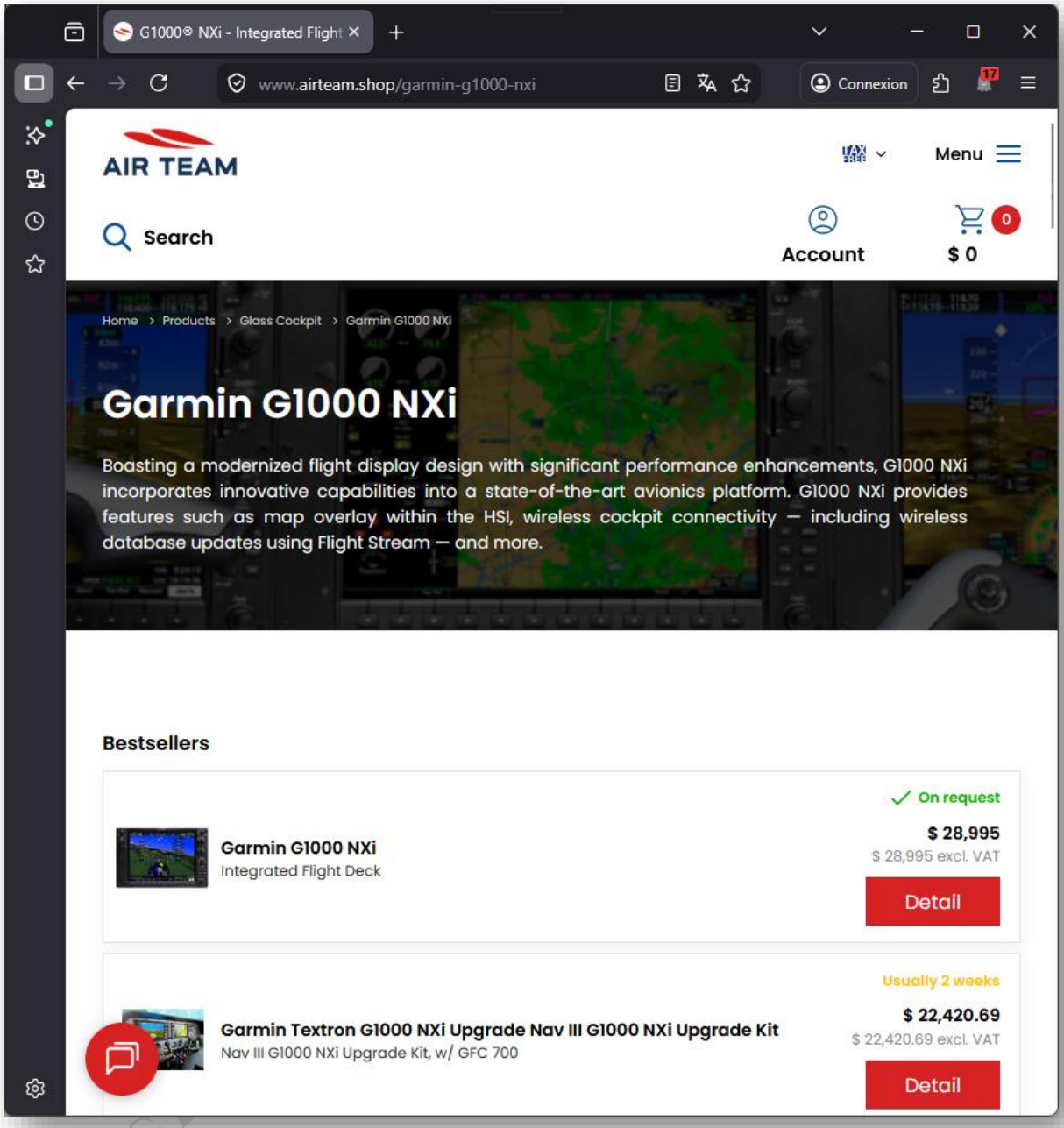
In the user manual for the Garmin G1000 Nxi navigation system (for a modest price of 28,995 USD …), pictured below:

Figure 123 Garmin G1000 Nxi

And which can be ordered here:

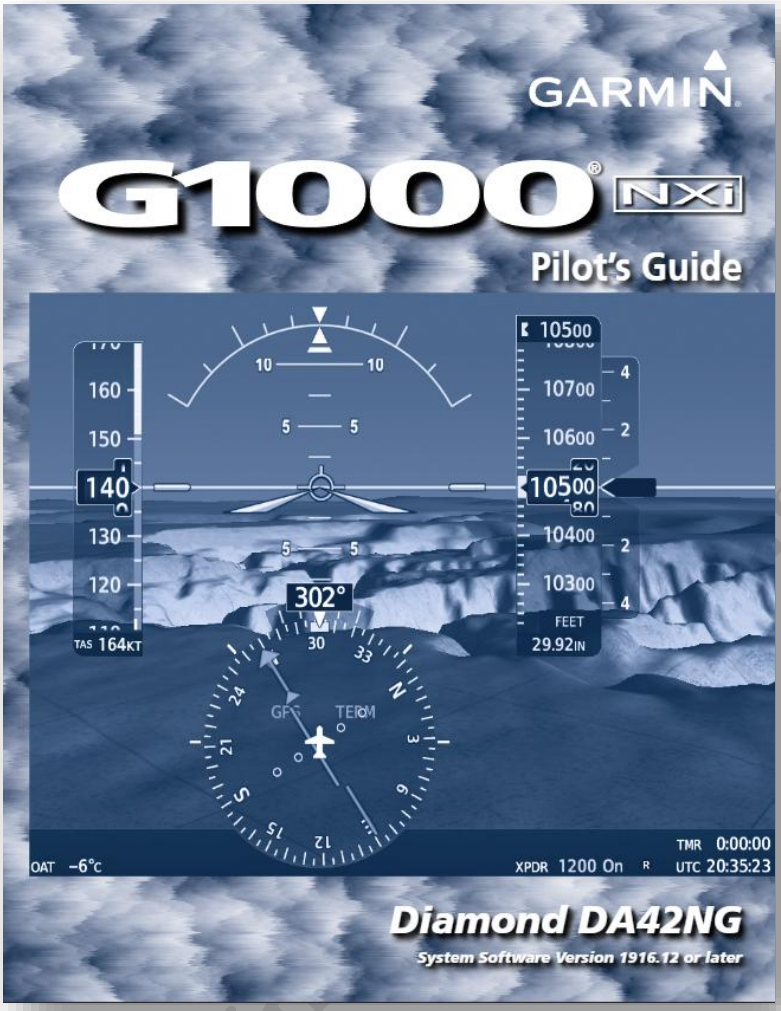
https://www.airteam.eu/fr/garmin-g1000-nxi

translation in


G1000® NXi - Integrated Flight
www.airteam.shop/garmin-g1000-nxi
Connexion
AIR TEAM
Menu
Search
Account
$ 0
Home › Products › Glass Cockpit › Garmin G1000 NXi
Garmin G1000 NXi
Boasting a modernized flight display design with significant performance enhancements, G1000 NXi incorporates innovative capabilities into a state-of-the-art avionics platform. G1000 NXi provides features such as map overlay within the HSI, wireless cockpit connectivity — including wireless database updates using Flight Stream — and more.
Bestsellers
On request
Garmin G1000 NXi
Integrated Flight Deck
$ 28,995
$ 28,995 excl. VAT
Detail
Usually 2 weeks
Garmin Textron G1000 NXi Upgrade Nav III G1000 NXi Upgrade Kit
Nav III G1000 NXi Upgrade Kit, w/ GFC 700
$ 22,420.69
$ 22,420.69 excl. VAT
Detail

Furthermore, in its user manual, available online for free here:

https://www.pilotenschule.ch/images/fsa/Downloads/HBLWA/Gamin_G1000nxi_Pilots_Guide_1_2.pdf



…it is indicated several times that one must be careful of the limitations due to the curvature of the Earth, as on page 314:

translation in progress

The following figure depicts the radar beam as seen from the side, with both the certified beam width and the additional beam energy illustrated. With the aircraft at 30,000 ft. AGL and a radar tilt angle of zero degrees, ground clutter may be observed starting at approximately 30 NM. The cell located 20 NM from own ship would be over-scanned by the beam, and as a result would not be represented on the radar display. The cell located 80 NM from own ship displays radar tops of 22,000 ft. AGL which is relatively close to the beam center, so this cell would be represented on the display. However, utilizing a lower radar tilt angle would better depict the precipitation intensities of this cell. The cell located at approximately 190 NM displays radar tops of 28,000 ft. AGL, while the center of the beam is at about 65,500 ft. AGL (due to the Earth's curvature at that distance). While this particular cell may appear on the display due to being within the certified beam width, it would most likely be under-represented due to being so distant from the beam center. The radar tilt angle would need to be adjusted downwards to properly explore this cell's precipitation intensity.

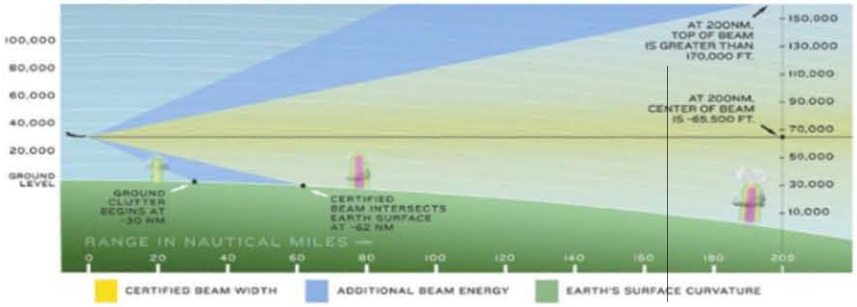


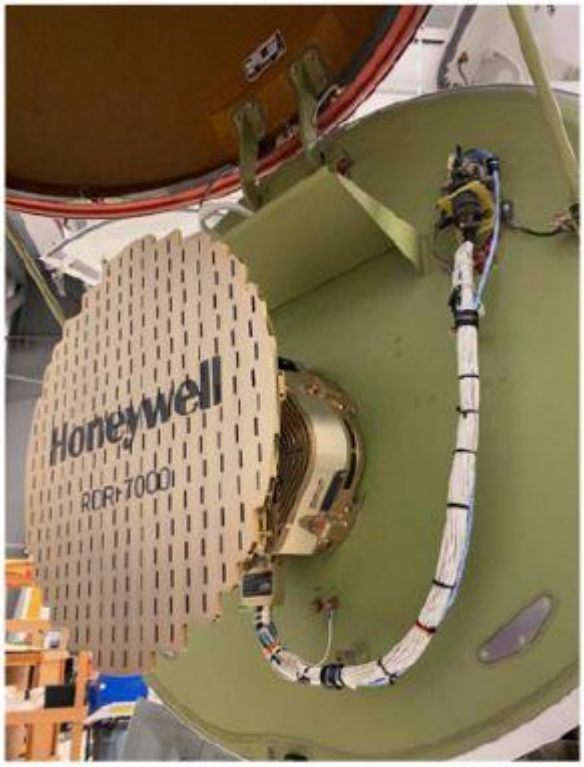
Figure 6-60 Radar Beam in Relation to the Curvature of the Earth from a 10 inch Antenna

translation into

(#219) Onboard Radar System

Honeywell IntuVue RDR-7000 Onboard Radar System

In the technical documentation for the Honeywell IntuVue RDR-7000 aircraft onboard radar system:



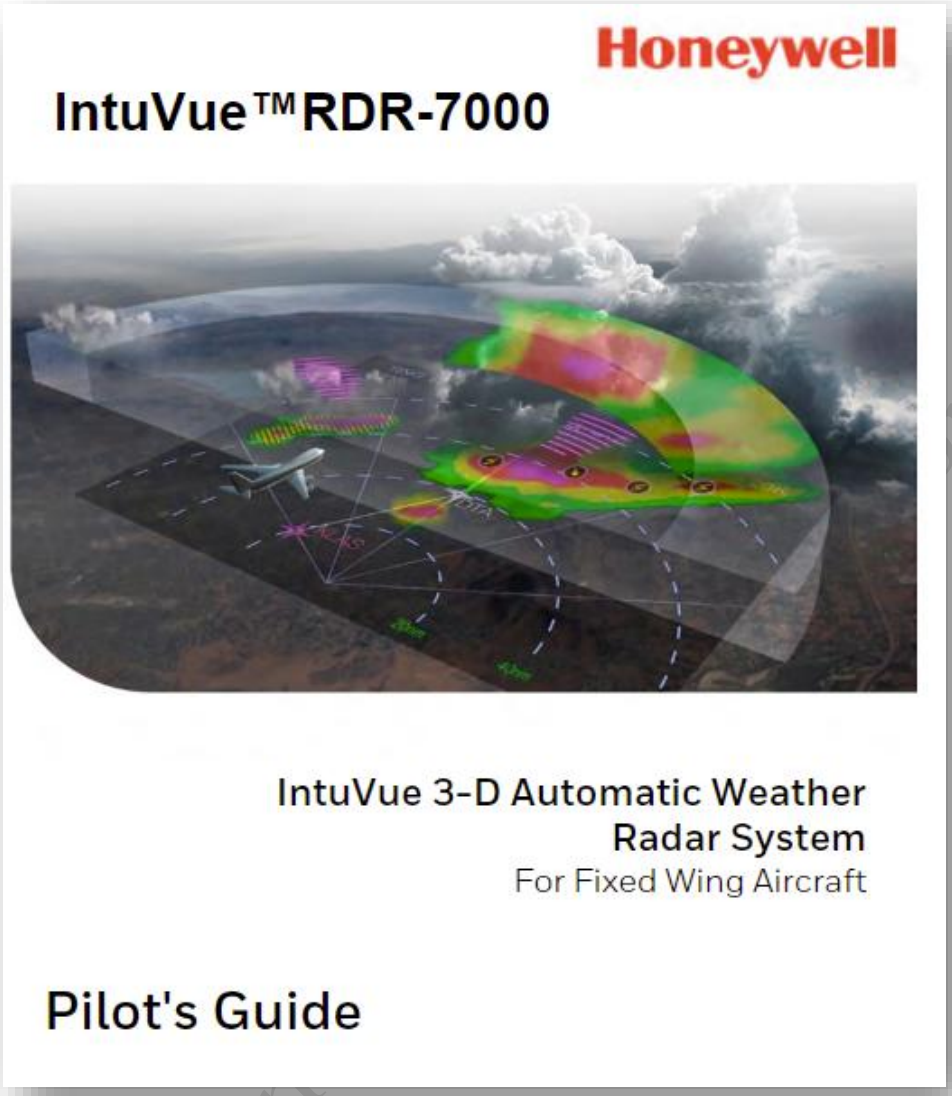
Radar image of mounted RDR-7000 in place of former radar system

WX image of storm cell with lightning 45nm south of Reno, NV.

Available at the following address:

https://fcc.report/FCC-ID/AOIRDR7000/4684536.pdf

translation



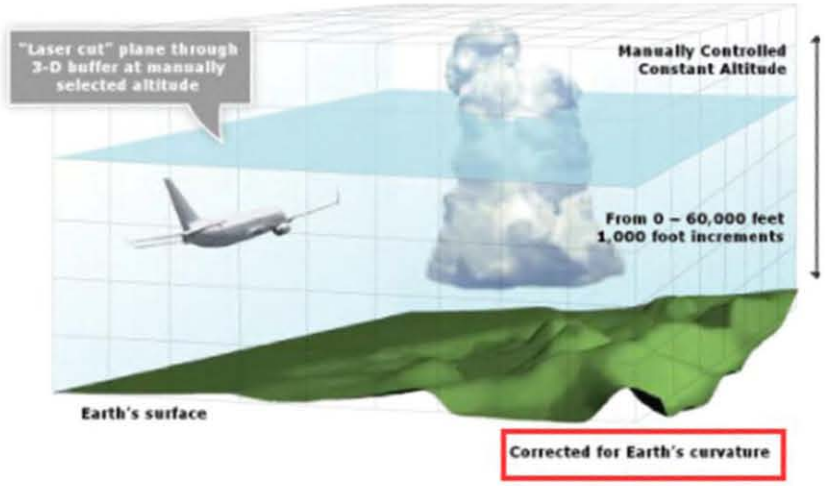
We have five mentions that the system adjusts to the curvature of the Earth, for example on page 28:

WEATHER ANALYSIS

MANUAL ALTITUDE WEATHER MODE

WX MAN Weather Modeprovides a means to assess storm cell height and development by providing selectable altitude slices. These slices from the 3D memory are corrected for the curvature of the earth, providing a view at a constant altitude level.

The altitude control is used to select the desired altitude slice from 0 to 60,000 feet, in increments of 1,000 feet.


"Laser cut" plane through 3-D buffer at manually selected altitude
Manually Controlled Constant Altitude
From 0 – 60,000 feet 1,000 foot increments
Earth's surface
Corrected for Earth's curvature

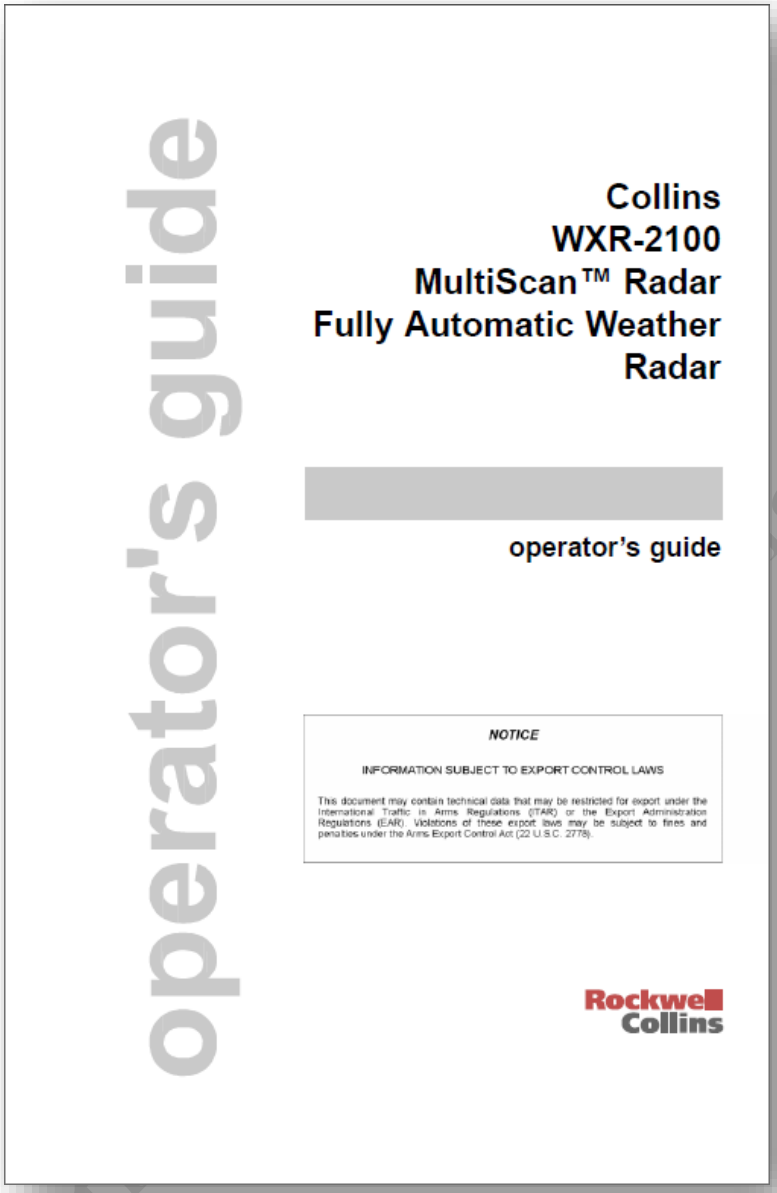
Collins WXR-2100 MultiScan™ Radar

In the technical documentation for the onboard radar system for Collins WXR-2100 MultiScan™ Radar:

Available at the following address:

https://aviation4all.wordpress.com/wp-content/uploads/2016/09/collins_wxr-2100_operators_guide.pdf

translation into e going

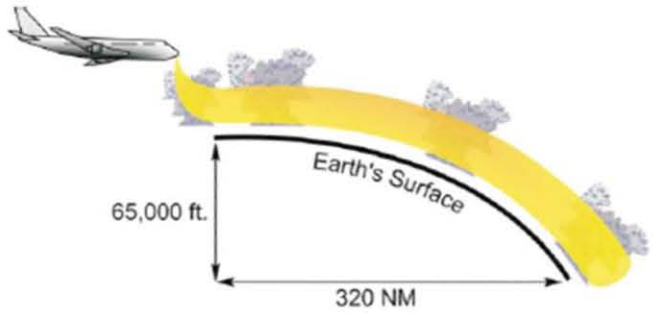

operator's guide
Collins
WXR-2100
MultiScan™ Radar
Fully Automatic Weather
Radar
operator's guide
NOTICE
INFORMATION SUBJECT TO EXPORT CONTROL LAWS
This document may contain technical data that may be restricted for export under the International Traffic in Arms Regulations (ITAR) or the Export Administration Regulations (EAR). Violations of these export laws may be subject to fines and penalties under the Arms Export Control Act (22 U.S.C. 2778).
Rockwell
Collins

We have several mentions that the system adjusts to the curvature of the Earth, for example on page 30:

THE IDEAL RADAR BEAM

Understanding thunderstorm reflectivity and the effect that radar tilt angle has on it allows us to envision a hypothetical ideal radar beam for weather threat detection. The ideal radar beam would look directly below the aircraft to detect building thunderstorms and then follow the curvature of the earth out to the radar's maximum range (figure 3-4). Thus, the ideal beam would keep the reflective part of all significant weather in view at all times, from right at the aircraft out to 320 NM.

Figure 3-4 Ideal Radar Beam



NOTE

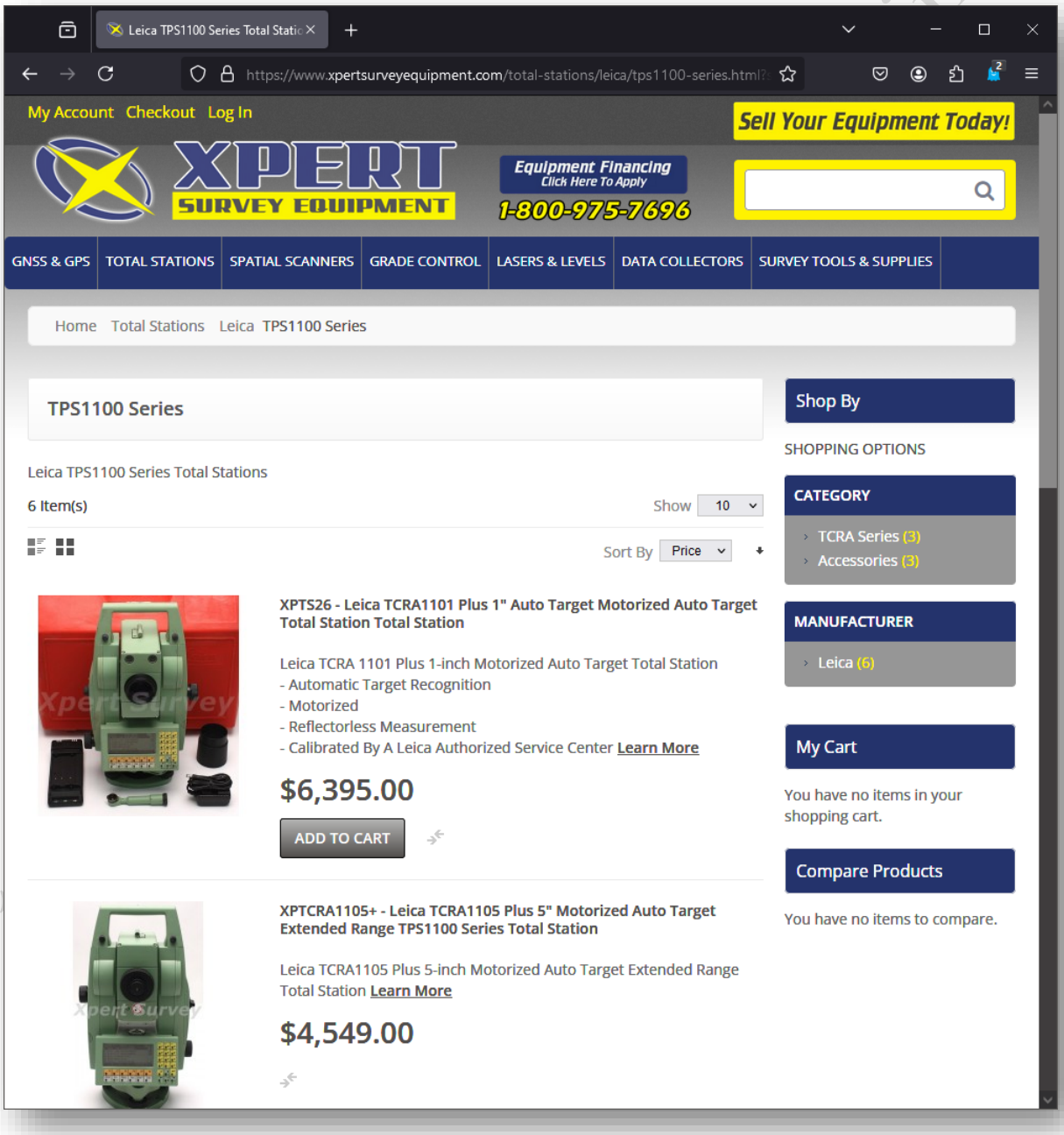
Note that the earth's curvature causes a drop of approximately 65,000 feet over a distance of 320 nautical miles.

(#220) Operating Instructions for Surveyor Total Stations

Leica TPS1100 Professional Series Total Station

Modern surveyors use what is commonly called “Total stations” for professional surveys. The best-known and most reputable brand to date is Leica and its TPS1000 series; here is an idea of the prices :

https://www.xpertsurveyequipment.com/total-stations/leica/tps1100-series.html?srsltid=AfmBOoqm5_Q4R2qXY08zZjjlKIEeojPvDXgnav4shRHfGplrs5h8iX2D

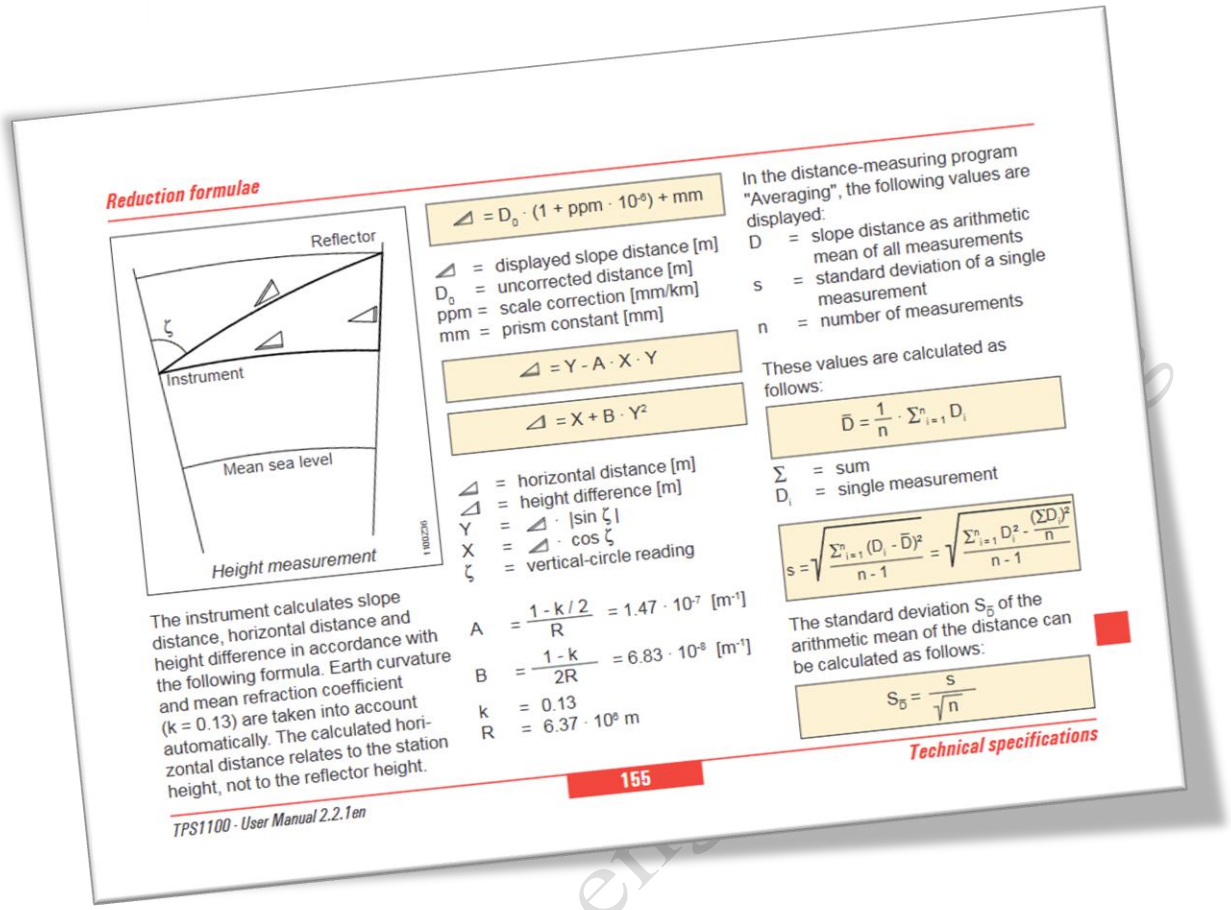


In the 160 pages user manual available for free here:

https://tmackinnon.com/2005/PDF/Leica_TPS1100-User_FieldManual_en.pdf

On page 155, we have information indicating that the station automatically corrects for the curvature of the Earth:

translation int



Reduction formulae

Reflector
ζ
Instrument
Mean sea level
Height measurement
19620011

The instrument calculates slope distance, horizontal distance and height difference in accordance with the following formula. Earth curvature and mean refraction coefficient (k = 0.13) are taken into account automatically. The calculated horizontal distance relates to the station height, not to the reflector height.

$\measuredangle = D_0 \cdot (1 + ppm \cdot 10^{-6}) + mm$

$\measuredangle$ = displayed slope distance [m]
D_0 = uncorrected distance [m]
ppm = scale correction [mm/km]
mm = prism constant [mm]

$\measuredangle = Y - A \cdot X \cdot Y$

$\measuredangle = X + B \cdot Y^2$

$\measuredangle$ = horizontal distance [m]
$\measuredangle$ = height difference [m]
Y = $\measuredangle \cdot |\sin \zeta|$
X = $\measuredangle \cdot \cos \zeta$
ζ = vertical-circle reading

$A = \frac{1 - k/2}{R} = 1.47 \cdot 10^{-7}\ [m^{-1}]$

$B = \frac{1 - k}{2R} = 6.83 \cdot 10^{-8}\ [m^{-1}]$

k = 0.13
R = $6.37 \cdot 10^6$ m

In the distance-measuring program "Averaging", the following values are displayed:

D = slope distance as arithmetic mean of all measurements
s = standard deviation of a single measurement
n = number of measurements

These values are calculated as follows:

$\bar{D} = \frac{1}{n} \cdot \Sigma_{i=1}^{n} D_i$

Σ = sum
D_i = single measurement

$s = \sqrt{\frac{\Sigma_{i=1}^{n} (D_i - \bar{D})^2}{n-1}} = \sqrt{\frac{\Sigma_{i=1}^{n} D_i^2 - \frac{(\Sigma D_i)^2}{n}}{n-1}}$

The standard deviation $S_{\bar{D}}$ of the arithmetic mean of the distance can be calculated as follows:

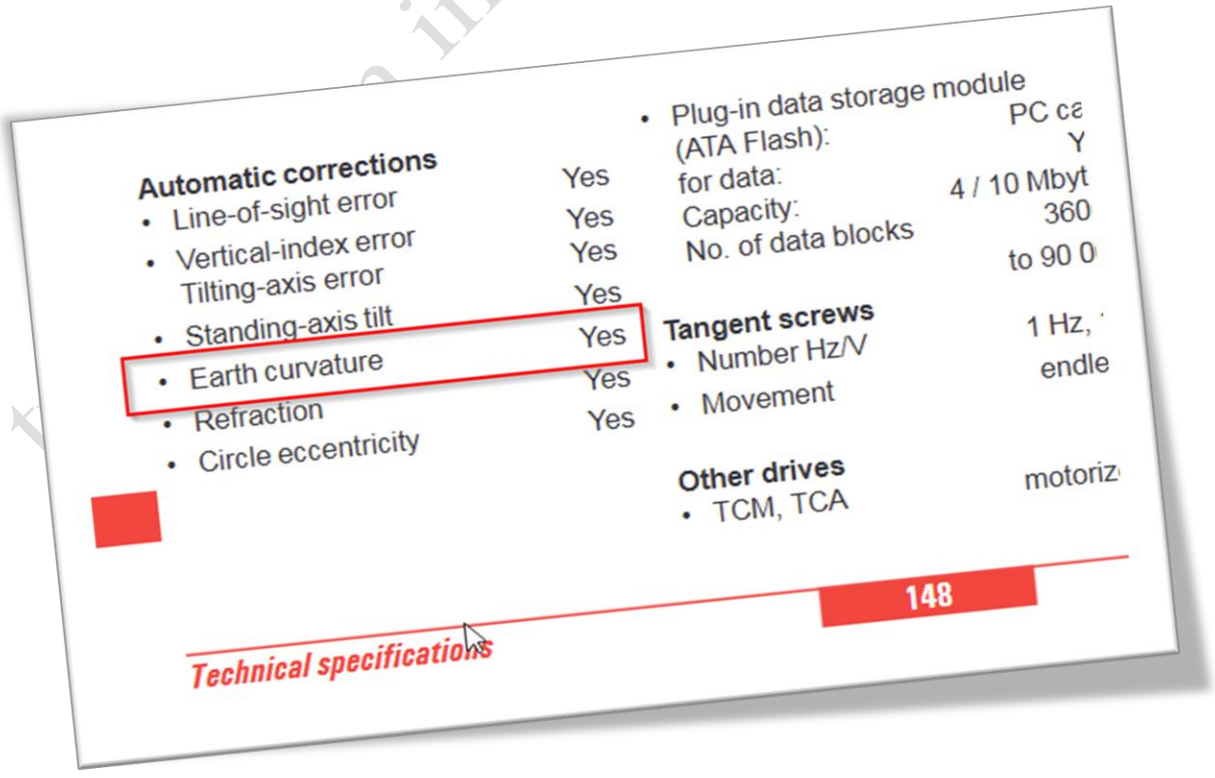
$S_{\bar{D}} = \frac{s}{\sqrt{n}}$

155

TPS1100 - User Manual 2.2.1en

Technical specifications

And on page 144 we also have the summary stating that the curvature correction is automated:



Automatic corrections

- Line-of-sight error — Yes
- Vertical-index error — Yes
- Tilting-axis error — Yes
- Standing-axis tilt — Yes
- Earth curvature — Yes
- Refraction — Yes
- Circle eccentricity — Yes

- Plug-in data storage module (ATA Flash): — PC ca
- for data: — Y
- Capacity: — 4 / 10 Mbyt
- No. of data blocks — 360 to 90 0

Tangent screws

- Number Hz/V — 1 Hz,
- Movement — endle

Other drives

- TCM, TCA — motoriz

148

Technical specifications

Note in passing that this station can measure up to 7 kilometers:

Introduction

TPS1100 stands for **T**otal **S**tation **P**ositioning **S**ystem. The TPS1100 instruments are available as various models with differing classes of accuracy. New technologies have enabled the measuring sequence to be largely automated, bringing advantages such as shorter measuring times, simpler operation and more efficient use. Further elements in the basic equipment are described below.

The **R** versions have a laser with a visible red beam. The EDM can be switched between two operational modes: measurements with normal infrared or with the visible red laser respectively. With the red laser, reflectors are not required for measuring distances. With infrared, distances of up to seven kilometres can be measured.

All TPS1100 instruments are routinely supplied with a laser plummet located in the vertical axis. The TPS1100 can therefore be set up quickly and accurately over the ground point with the help of the red laser dot.

The A-versions have an automatic target recognition (**ATR**), which permits rapid, fatigue-free measuring. In ATR mode the fine-pointing is automatic. In LOCK mode an already-targeted point is tracked automatically.
For TPS1100 plus instruments an optional PowerSearch module is available which allows an automatic prism detection within a short period of time.

The **EGL** guide light is an optional accessory for assistance with targeting. It is located within the telescope and it flashes, so that the person carrying the reflector can place this in the line of sight of the instrument.
The RCS1100 remote control system is an additional option, which allows the remote control of all total stations. The instrument can be controlled either directly on the instrument or at the RCS1100. Especially the A-versions enable the surveyor to work alone.
The measurements can also be triggered, inspected and controlled from the target area.

Leica Geosystems offers **applications programs** for many different tasks in surveying. Just choose the software which best meets your needs.

Within the special **GeoBasic** programming environment, you can create your own application-specific programs for the TPS1100 instruments.

translation into e

Electronic GTS-220 and FTS 300 Series Total Station

Another series of total stations takes into account not only the curvature of the Earth but also atmospheric refraction, such as:

https://geo-fennel.de/media/pdf/7d/71/cf/FTS-300_EN.pdf

And we have a page in this manufacturer's manuals with the following text:

13 CORRECTION FOR REFRACTION AND EARTH CURVATURE

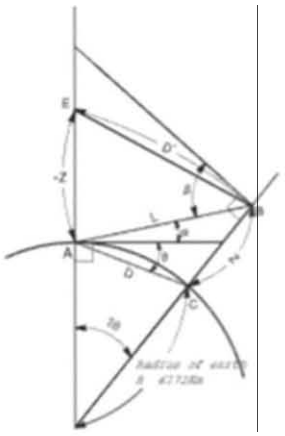
The instrument measures distance, taking into account correction for refraction and earth curvature.

13.1 Distance Calculation Formula

Distance Calculation Formula; with correction for refraction and earth curvature taken into account. Follow the Formula below for converting horizontal and vertical distances.

Horizontal distance D = AC(α) or BE(β)
Vertical distance Z =BC(α) or EA(β)
$D = L\{\cos\alpha - (2\theta - \gamma)\sin\alpha\}$
$Z = L\{\sin\alpha + (\theta - \gamma)\cos\alpha\}$

$\theta = L\cos\alpha/2R$	Earth curvature correcting item
$\gamma = K \cdot L\cos\alpha/2R$	Atmospheric refraction correcting item
K =0.14 or 0.2	Coefficient of refraction
R =6372km	Radius of earth
α (or β)	Altitude angle
L	Slope distance



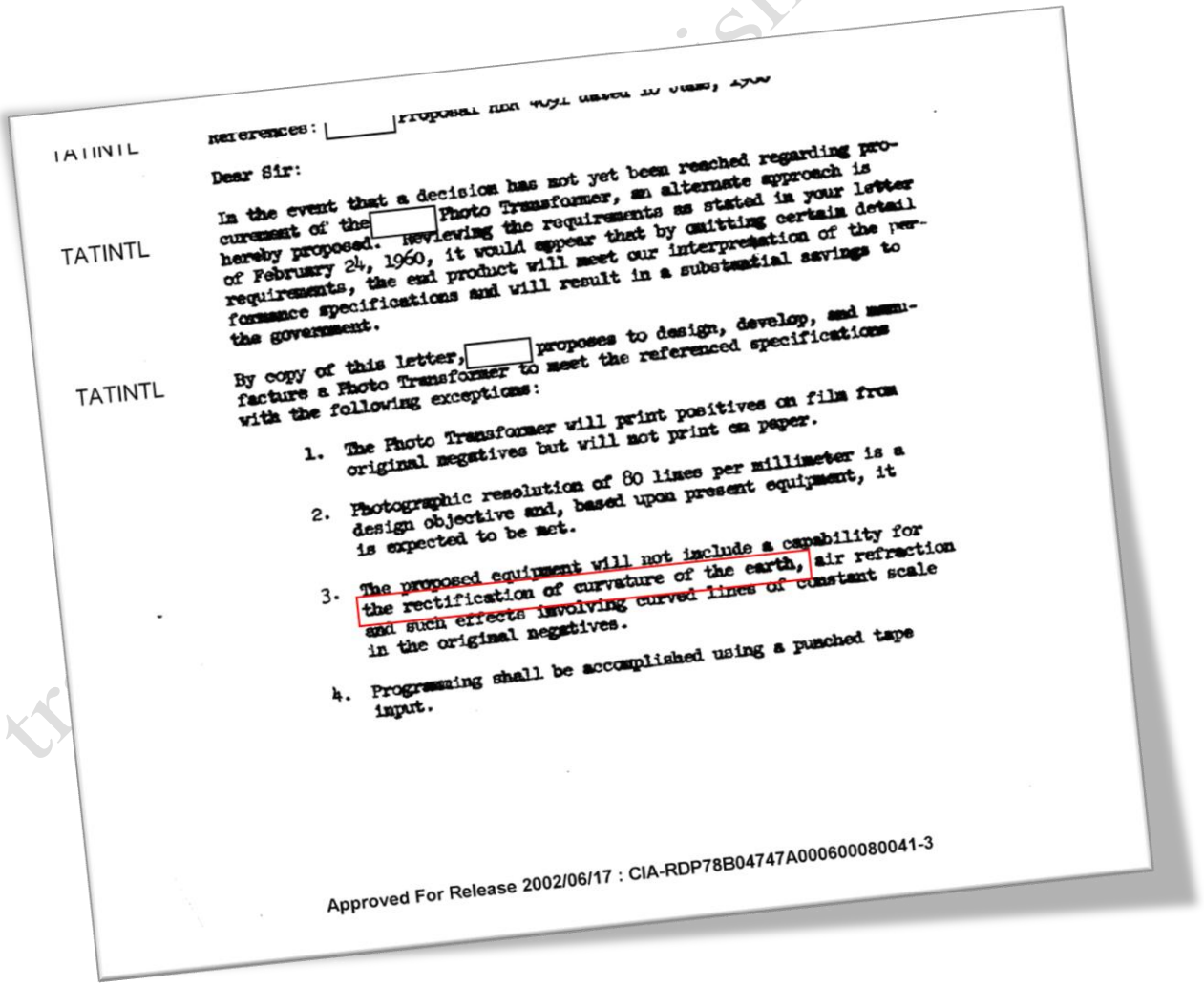
- The conversion formula for horizontal and vertical distances is as follows when correction for refraction and earth curvature is not applied.
  $D = L \cdot \cos\alpha$
  $Z = L \cdot \sin\alpha$

Note: The coefficient of the instrument has been set at 0.14 before shipment (K=0.14). If the "K" value is to be changed, refer to 16 "SELECTING MODE".

(#221) Central Intelligence Agency (CIA)

The Central Intelligence Agency (CIA), founded in 1947 by the National Security Act, is one of the best-known intelligence agencies in the United States. It is responsible for intelligence gathering (particularly through espionage) and most clandestine operations conducted outside the United States.

https://www.cia.gov/readingroom/docs/CIA-RDP78B04747A000600080041-3.pdf



TATINTL

References: [redacted] Proposal

Dear Sir:

In the event that a decision has not yet been reached regarding procurement of the [redacted] Photo Transformer, an alternate approach is hereby proposed. Reviewing the requirements as stated in your letter of February 24, 1960, it would appear that by omitting certain detail requirements, the end product will meet our interpretation of the performance specifications and will result in a substantial savings to the government.

TATINTL

By copy of this letter, [redacted] proposes to design, develop, and manufacture a Photo Transformer to meet the referenced specifications with the following exceptions:

1. The Photo Transformer will print positives on film from original negatives but will not print on paper.
2. Photographic resolution of 80 lines per millimeter is a design objective and, based upon present equipment, it is expected to be met.
3. The proposed equipment will not include a capability for the rectification of curvature of the earth, air refraction and such effects involving curved lines of constant scale in the original negatives.
4. Programming shall be accomplished using a punched tape input.

Approved For Release 2002/06/17 : CIA-RDP78B04747A000600080041-3

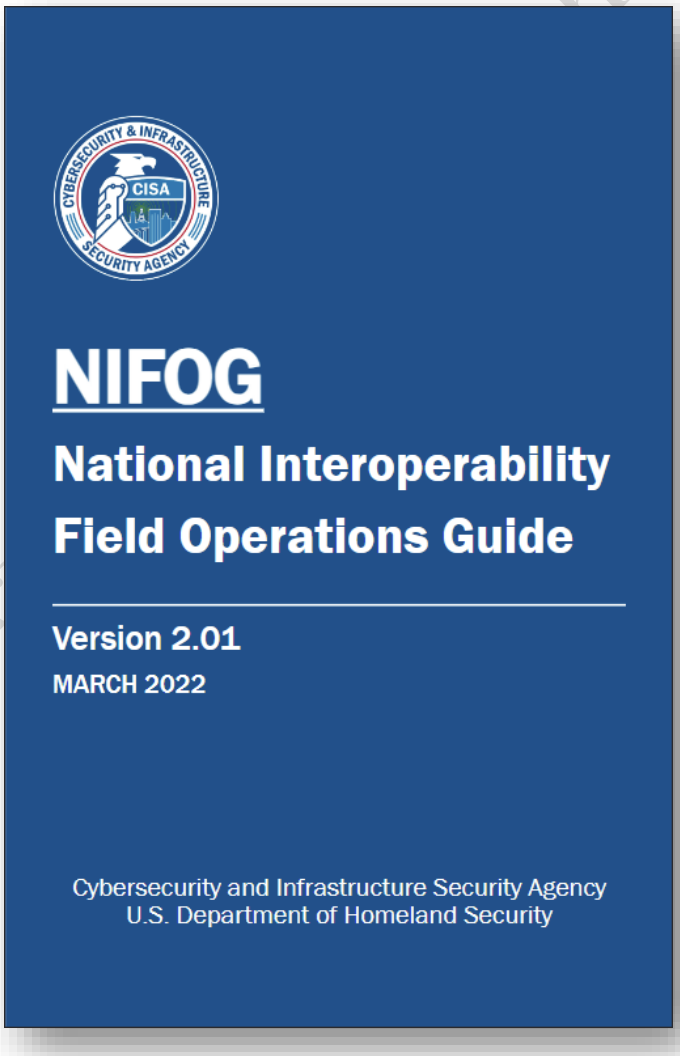
ongoing

(#222) Cybersecurity & Infrastructure Security Agency (CISA)

The Cybersecurity and Infrastructure Security Agency (CISA) is a U.S. federal agency under the supervision of the U.S. Department of Homeland Security, created on November 16, 2018 following the enactment of the Cybersecurity and Infrastructure Security Agency Act of 2018.

In its reference framework:

https://www.cisa.gov/sites/default/files/2023-04/NIFOG%202.01_508%20FINAL%20VERSION%205%2011%2022.pdf



On page 67 we find the calculation for taking into account the Earth's curvature in a vacuum (without refraction):

Line-of-Sight Formulas

Earth's Curvature

Approximately 8 inches (7.98) per Mile

Visual Line-of-Sight

Approximate distance in miles = 1.33 x √ (height in feet)

Radio Line-of-Sight

D = √(2Hr) + √(2Ht)

Where:
D = approximate distance (range) to radio horizon in miles
Hr = height of receive antenna in feet
Ht = height of transmit antenna in feet

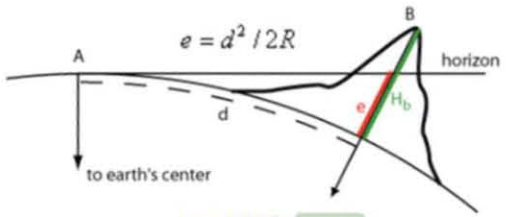


Figure 2: Earth's Curvature

These are rough estimates that only consider the curvature of the earth, which does not take into account power, antenna type, antenna gain, frequency, clutter, terrain or other obstructions.

Range (miles)	8	10	11	12	13	16	17	21	23	28	32	35	42	48
Tx Ant. Height (ft)	10	20	30	40	50	75	100	150	200	300	400	500	750	1000
Rx Ant. Height (ft)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5

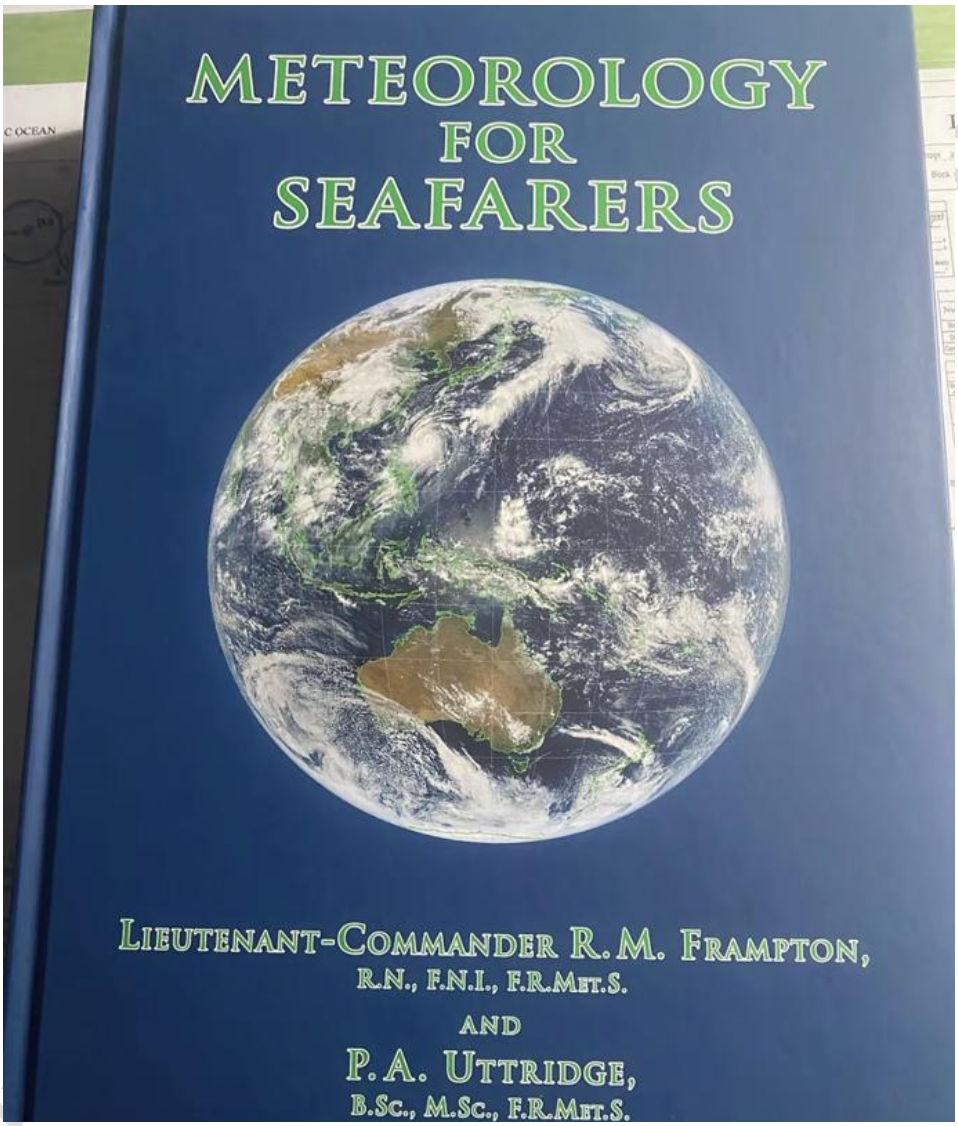
67

translation into e... ng

(#223) Meteorology for Seafarers

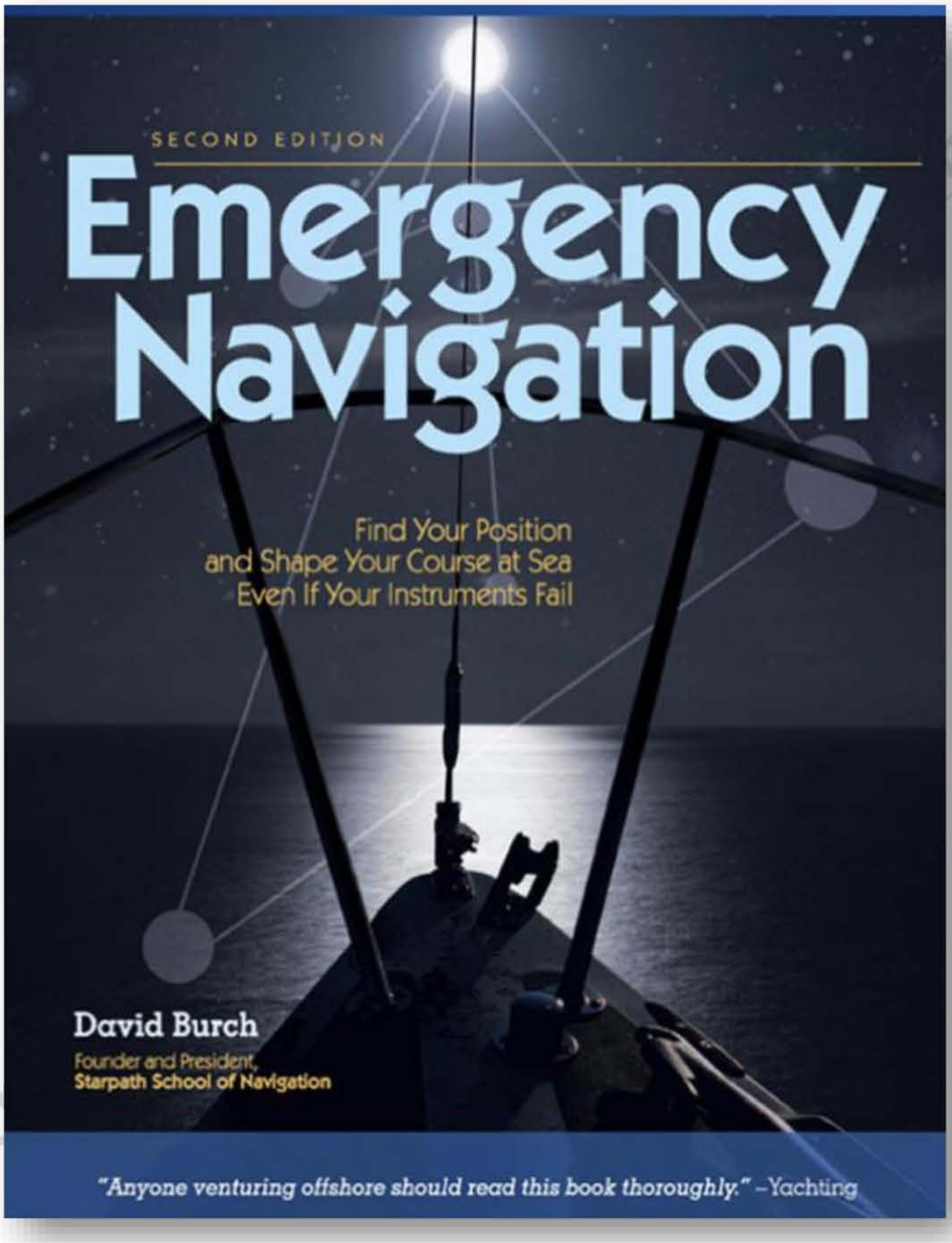
"**Meteorology for Seafarers**" is a 174 pages book first published in 1988 and designed for sailors and navigators who wish to understand the basic principles of meteorology applied to maritime navigation.

As you can see, the front cover of this book depicts a globe, not a flat Earth…



(#224) Emergency Navigation

In their usual lies and manipulations on social media, flat-Earthers claim, without ever showing the page and the relevant passage, that the following french book, *Emergency Navigation* by David Burch (an experienced competitive sailor), uses a flat Earth model:


SECOND EDITION
Emergency Navigation
Find Your Position
and Shape Your Course at Sea
Even If Your Instruments Fail
David Burch
Founder and President,
Starpath School of Navigation
"Anyone venturing offshore should read this book thoroughly." –Yachting

However, there are numerous passages mentioning the globe or illustrating it (the Earth's sphere). For example, on page 10:

from what you see in the sky. You will only be able to keep track of how far you sail east or west. Hence the potential usefulness of the hybrid notation.

LATITUDE REGIONS AND SEASONS DEFINED

In emergency navigation and meteorology, it is convenient to divide the globe into latitude bands according to the relationship of the sun to the earth. The three regions are the tropics, the temperate latitudes, and the polar regions.

The tropics are defined as the central belt of the earth extending between latitudes of about 23° 26′ S to 23° 26′ N. The special latitude of 23° 26′ is derived from the orientation of the earth's rotation axis, which is tilted 23° 26′ relative to the plane of its orbit around the sun. Because of this tilt, the sun can be viewed precisely overhead only from somewhere within the tropics (see Figure 2-1 and, looking ahead, Figure 11-14). During the fall and winter (from the autumnal equinox on September 23 to the vernal equinox on March 21), the sun is directly overhead at some latitude in the southern tropics. During the spring and summer, the sun is directly overhead at

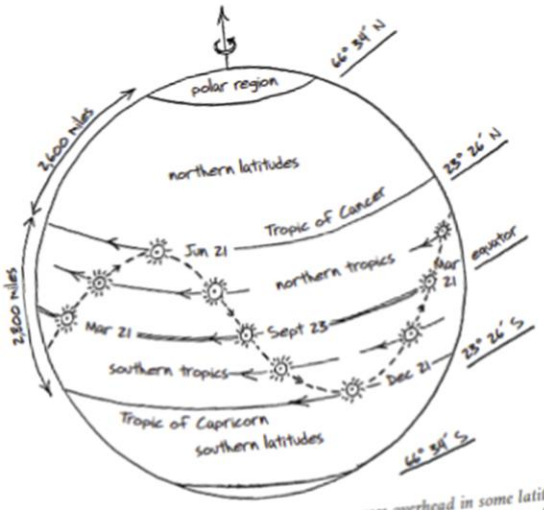


Figure 2-1. Latitude regions in emergency navigation. The sun passes overhead in some latitude of the tropics, defined by the northern and southern limits of the sun's latitude. Some rules and procedures of emergency navigation work only in the tropics (40% of the earth's surface), and many of the methods we cover do not work in the polar regions (8% of the earth's surface). The temperate latitudes between these two regions comprise 52% of the earth's surface. Figure 11-14 explains why the sun moves over the earth as shown here. In Chapter 11, we use the location of the sun to find latitude.

CHAPTER 2

So yet another lie and manipulation… But further proof in favor of the globe since we have a senior and renowned competitive sailor who confirms that the Earth is a globe!

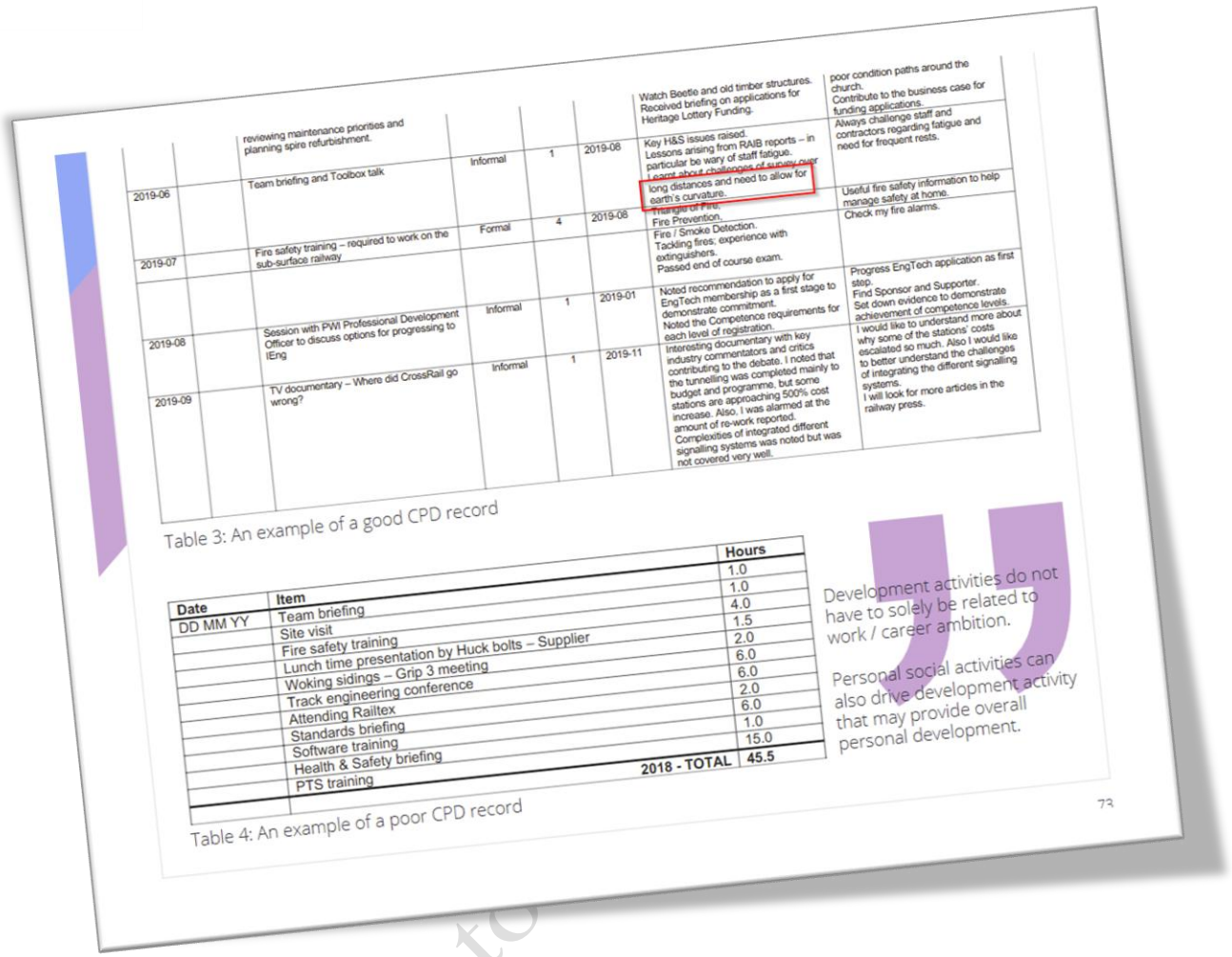
(#225) Railway construction

Let's demonstrate that railway construction takes the Earth's curvature into account by the fact that engineers in the field must learn to consider this curvature during their training. For example, in volume 137, part 4 of the PWI journal from October 2019 (a railway association with 3300 members, founded in 1884):

https://www.thepwi.org/wp-content/uploads/2021/02/Journal-201910-Vol137-Pt4.pdf

THE
JOURNAL
OCTOBER 2019 VOL 137 PART 4
£15.00 (FREE FOR MEMBERS) 4 ISSUES ANNUALLY
Permanent Way Institution The Institution for Rail Infrastructure Engineers
A new design method for geogrid-stabilised trackbed
ANDREW LEES
PAGE 24
RAILWAY EARTHWORK INSTABILITY, CHITTS HILL EMBANKMENT
Page 26
COLLECTING ASSET DATA AND GENERATING INTELLIGENCE
Page 38
WHAT IN THE WORLD? HUDSON BAY RAILWAY
Page 62

We have on page 77:



		reviewing maintenance priorities and planning spire refurbishment.				Watch Beetle and old timber structures. Received briefing on applications for Heritage Lottery Funding.	poor condition paths around the church. Contribute to the business case for funding applications.
2019-06		Team briefing and Toolbox talk	Informal	1	2019-08	Key H&S issues raised. Lessons arising from RAIB reports – in particular be wary of staff fatigue. Learnt about challenges of survey over long distances and need to allow for earth's curvature. Triangle of Fire, Fire Prevention,	Always challenge staff and contractors regarding fatigue and need for frequent rests.
2019-07		Fire safety training – required to work on the sub-surface railway	Formal	4	2019-08	Fire / Smoke Detection. Tackling fires; experience with extinguishers. Passed end of course exam.	Useful fire safety information to help manage safety at home. Check my fire alarms.
2019-08		Session with PWI Professional Development Officer to discuss options for progressing to IEng	Informal	1	2019-01	Noted recommendation to apply for EngTech membership as a first stage to demonstrate commitment. Noted the Competence requirements for each level of registration.	Progress EngTech application as first step. Find Sponsor and Supporter. Set down evidence to demonstrate achievement of competence levels.
2019-09		TV documentary – Where did CrossRail go wrong?	Informal	1	2019-11	Interesting documentary with key industry commentators and critics contributing to the debate. I noted that the tunnelling was completed mainly to budget and programme, but some stations are approaching 500% cost increase. Also, I was alarmed at the amount of re-work reported. Complexities of integrated different signalling systems was noted but was not covered very well.	I would like to understand more about why some of the stations' costs escalated so much. Also I would like to better understand the challenges of integrating the different signalling systems. I will look for more articles in the railway press.

Table 3: An example of a good CPD record

Date	Item	Hours
DD MM YY	Team briefing	1.0
	Site visit	1.0
	Fire safety training	4.0
	Lunch time presentation by Huck bolts – Supplier	1.5
	Woking sidings – Grip 3 meeting	2.0
	Track engineering conference	6.0
	Attending Railtex	6.0
	Standards briefing	2.0
	Software training	6.0
	Health & Safety briefing	1.0
	PTS training	15.0
	2018 - TOTAL	45.5

Table 4: An example of a poor CPD record

Development activities do not have to solely be related to work / career ambition.

Personal social activities can also drive development activity that may provide overall personal development.

73

Or with a zoom:

			Heritage Lottery Funding.	Contribut funding a
ıal	1	2019-08	Key H&S issues raised. Lessons arising from RAIB reports – in particular be wary of staff fatigue. Learnt about challenges of survey over long distances and need to allow for earth's curvature.	Always c contracto need for
al	4	2019-08	Triangle of Fire, Fire Prevention,	Useful fir manage

(#226) The meridian line of the Royal Observatory of Paris (definition of the meter)

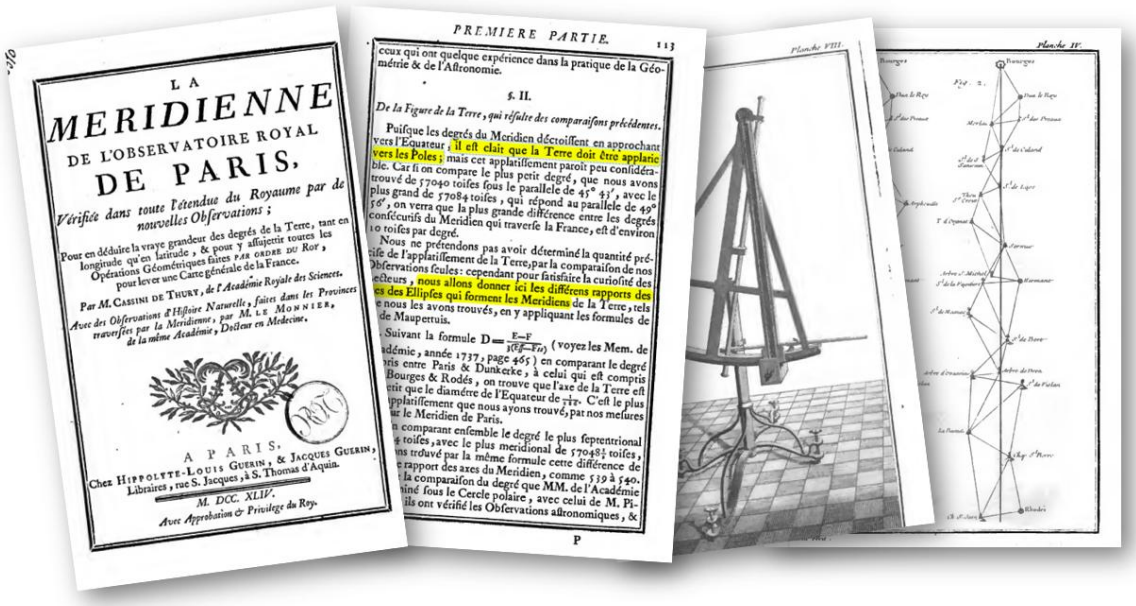
Giovanni Domenico Cassini's 600-pages work, "*The meridian of the royal observatory of Paris, throughout its extent of the Kingdom by new observations*" of 1744, is significant proof that the Earth is an oblate sphere.

Giovanni Cassini, also known as Cassini I, was an Italian-French astronomer who conducted important observations in the 17th century. In this work, Cassini describes and provides his precise measurements of the Paris Meridian, an imaginary line that runs north to south across France.

Cassini and his team measured the length of a degree of latitude at different latitudes along the meridian. By comparing these measurements, they discovered that the length of a degree of latitude increased the closer one got to the poles. This meant that the Earth was not a perfect sphere, but slightly flattened at the poles and bulging at the equator, thus forming an oblate sphere.

These observations were crucial in corroborating the theory of the Earth's oblate shape, which had been proposed by Isaac Newton. Before these measurements, there was a debate between proponents of the Earth's oblate shape and those who believed the Earth was elongated at the poles (prolate sphere).

In summary, Cassini's work provides empirical evidence and precise measurements that have made it possible to demonstrate that the Earth is an oblate sphere, thus confirming an important theory in geodesy and astronomy.


LA
MERIDIENNE
DE L'OBSERVATOIRE ROYAL
DE PARIS,
Vérifiée dans toute l'étendue du Royaume par de nouvelles Observations ;
Pour en déduire la vraye grandeur des degrés de la Terre, tant en longitude qu'en latitude, & pour y assujettir toutes les Opérations Géométriques faites PAR ORDRE DU ROY, pour lever une Carte générale de la France.
Par M. CASSINI DE THURY, *de l'Académie Royale des Sciences.*
Avec des Observations d'Histoire Naturelle, faites dans les Provinces traversées par la Meridienne, par M. LE MONNIER, *de la même Académie, Docteur en Medecine.*
A PARIS,
Chez HIPPOLYTE-LOUIS GUERIN, & JACQUES GUERIN, Libraires, rue S. Jacques, à S. Thomas d'Aquin.
M. DCC. XLIV.
Avec Approbation & Privilege du Roy.

PREMIERE PARTIE. 113

ceux qui ont quelque expérience dans la pratique de la Géométrie & de l'Astronomie.

§. II.

De la Figure de la Terre, qui réfulte des comparaiſons précédentes.

Puiſque les degrés du Meridien décroiſſent en approchant vers l'Equateur, il eſt clair que la Terre doit être applatie vers les Poles ; mais cet applatiſſement paroît peu conſidérable. Car ſi on compare le plus petit degré, que nous avons trouvé de 57040 toiſes ſous le parallele de 45° 51′, avec le plus grand de 57084 toiſes, qui répond au parallele de 49° 56′, on verra que la plus grande différence entre les degrés conſécutifs du Meridien qui traverſe la France, eſt d'environ 10 toiſes par degré.

Nous ne prétendons pas avoir déterminé la quantité préciſe de l'applatiſſement de la Terre, par la comparaiſon de nos Obſervations ſeules : cependant pour ſatisfaire la curioſité des Lecteurs, nous allons donner ici les différens rapports des Ellipſes qui forment les Meridiens de la Terre, tels que nous les avons trouvés, en y appliquant les formules de M. de Maupertuis.

Suivant la formule $D = \frac{E-F}{\frac{1}{2}(E+F)}$ (voyez les Mem. de l'Académie, année 1737, page 465) en comparant le degré pris entre Paris & Dunkerke, à celui qui eſt compris entre Bourges & Rodés, on trouve que l'axe de la Terre eſt à celui que le diamétre de l'Equateur de $\frac{1}{212}$. C'eſt le plus grand applatiſſement que nous ayons trouvé, par nos meſures ſur le Meridien de Paris.

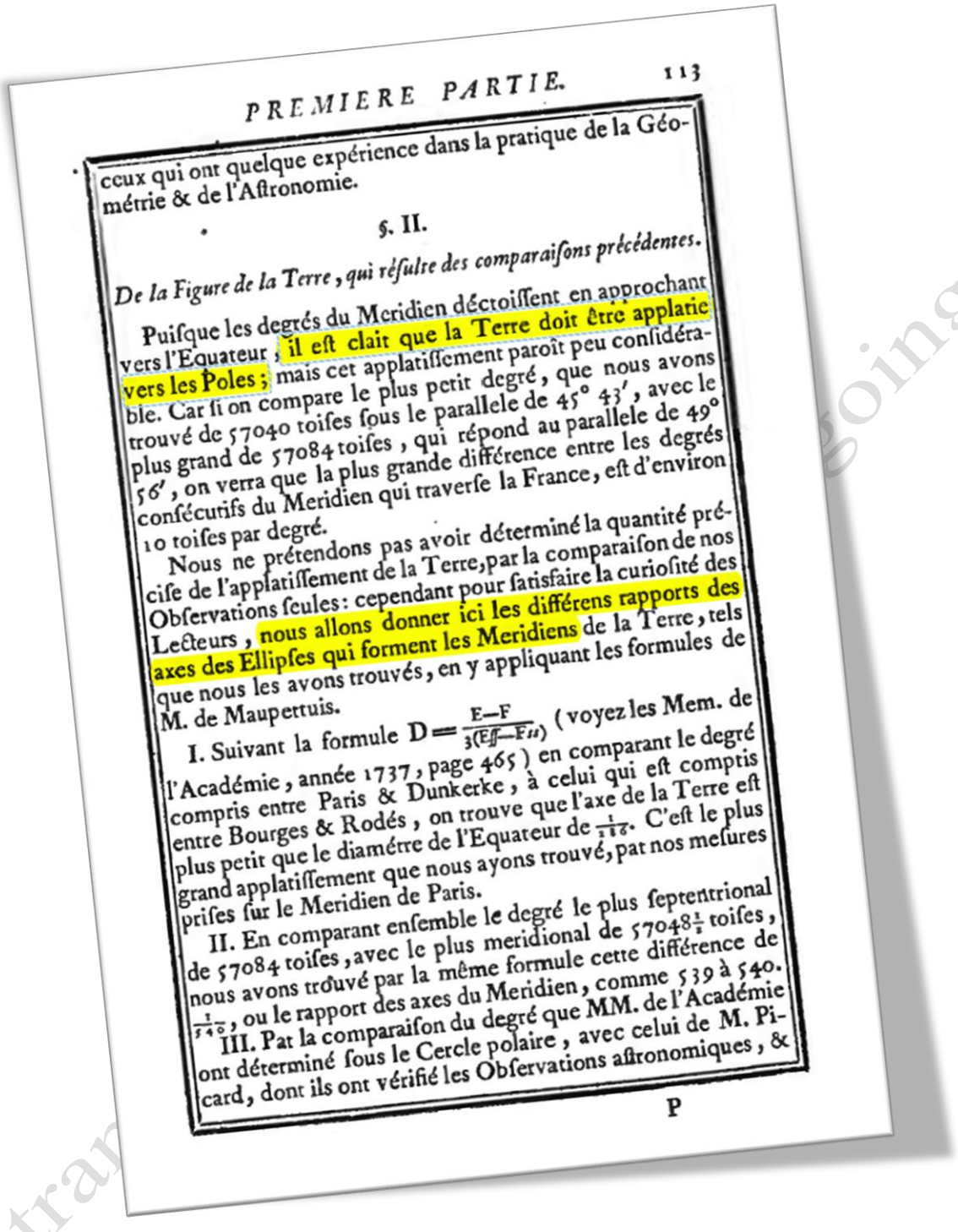
En comparant enſemble le degré le plus ſeptentrional de 57 toiſes, avec le plus meridional de 57048½ toiſes, on a trouvé par la même formule cette différence de $\frac{1}{178}$. Le rapport des axes du Meridien, comme 539 à 540. Par la comparaiſon du degré que MM. de l'Académie ont meſuré ſous le Cercle polaire, avec celui de M. Picard, ils ont vérifié les Obſervations aſtronomiques, &

P

Planche VIII

Planche IV.

Either with a zoom:



PREMIERE PARTIE. 113

ceux qui ont quelque expérience dans la pratique de la Géométrie & de l'Aſtronomie.

§. II.

De la Figure de la Terre, qui réſulte des comparaiſons précédentes.

Puiſque les degrés du Meridien décroiſſent en approchant vers l'Equateur, il eſt clair que la Terre doit être applatie vers les Poles; mais cet applatiſſement paroît peu conſidérable. Car ſi on compare le plus petit degré, que nous avons trouvé de 57040 toiſes ſous le parallele de 45° 43′, avec le plus grand de 57084 toiſes, qui répond au parallele de 49° 56′, on verra que la plus grande différence entre les degrés conſécutifs du Meridien qui traverſe la France, eſt d'environ 10 toiſes par degré.

Nous ne prétendons pas avoir déterminé la quantité préciſe de l'applatiſſement de la Terre, par la comparaiſon de nos Obſervations ſeules: cependant pour ſatisfaire la curioſité des Lecteurs, nous allons donner ici les différens rapports des axes des Ellipſes qui forment les Meridiens de la Terre, tels que nous les avons trouvés, en y appliquant les formules de M. de Maupertuis.

I. Suivant la formule $D = \frac{E-F}{3(Eff-Fii)}$ (voyez les Mem. de l'Académie, année 1737, page 465) en comparant le degré compris entre Paris & Dunkerke, à celui qui eſt compris entre Bourges & Rodés, on trouve que l'axe de la Terre eſt plus petit que le diamétre de l'Equateur de $\frac{1}{216}$. C'eſt le plus grand applatiſſement que nous ayons trouvé, par nos meſures priſes ſur le Meridien de Paris.

II. En comparant enſemble le degré le plus ſeptentrional de 57084 toiſes, avec le plus meridional de $57048\frac{1}{2}$ toiſes, nous avons trouvé par la même formule cette différence de $\frac{1}{540}$, ou le rapport des axes du Meridien, comme 539 à 540.

III. Par la comparaiſon du degré que MM. de l'Académie ont déterminé ſous le Cercle polaire, avec celui de M. Picard, dont ils ont vérifié les Obſervations aſtronomiques, &

P

The both texts in highlighted in yellow give once translate into English:

- "…, *it is crystal clear that the Earth must be flattened at the poles ;*"
- "… *we will give here the different ratios of the ellipses' axes that form the meridians…*"

Not to mention that the instrument used by Cassini and his colleagues is a "meridian line" and this instrument, like the sextant or the equatorial mount, cannot work on a flat Earth.

Moreover, the meridian of the Paris Observatory was important at the time because the definition of the meter is based on it and only makes sense if the Earth is a sphere.

In 1791, the Academy of Sciences decided to define the meter as one ten-millionth of the distance between the equator and the North Pole, measured along the Paris meridian. This definition aimed to establish a universal unit of measurement based on natural characteristics.

translation into english ongoing

(#227) Precision construction site LASER

Flat-Earthers sometimes try to prove that the Earth is flat through experiments. Although each of their experiments fails and demonstrates, on the contrary, that the Earth is not flat, instead of wasting time and money buying expensive equipment, they could have simply read the product catalog of LASER vendors.

Indeed, one of the top 5 manufacturers of precision construction LASERs details in its catalog that its LASERs are suitable for use even when taking into account the curvature of the Earth. This information is available in the company's 24-page LASER catalog, accessible through the link below in french:

https://www.meyer-meyer.com/app/download/3307562/Catalogue+Spectra+laser.pdf

There is a purchase recommendation note on page 6 that caught our attention:

LASERS

Guide d'achat

1. Que permettent de faire les lasers et comment savoir à quoi ils me seront utiles sur chantier ?

Les niveaux lasers peuvent vous proposer une référence pour établir :

- Niveau horizontal
- Alignement vertical
- Pente
- Nivellement automatique
- Paramétrage à 90 degrés
- Aplomb

Certains lasers possèdent seulement une des caractéristiques tandis que d'autres les ont toutes.

2. Dans quelle proportion la distance impacte-t-elle sur les fonctionnalités du laser ?

La précision du laser change en fonction de la distance. Plus la distance est importante, plus la courbure de la Terre a un impact. En outre, le récepteur que vous utilisez peut affecter la précision. Selon vos besoins, vous devez respecter un certain nombre de points si vous souhaitez améliorer la précision.

- **Planelok** – des radios placées dans le laser et le récepteur communiquent et verrouillent le faisceau laser sur une position en hauteur ou dans une direction établie (à la verticale). Le laser permet de maintenir l'orientation du faisceau vers le récepteur, et ce, en position fixe. Cela n'améliore pas uniquement la précision du dispositif puisque c'est également très utile pour les applications qui nécessitent une plus grande précision comme les dalles en béton. Cette fonctionnalité peut également éliminer le décalage du faisceau causé par les vibrations ou les variations des températures au cours de la journée.

translation

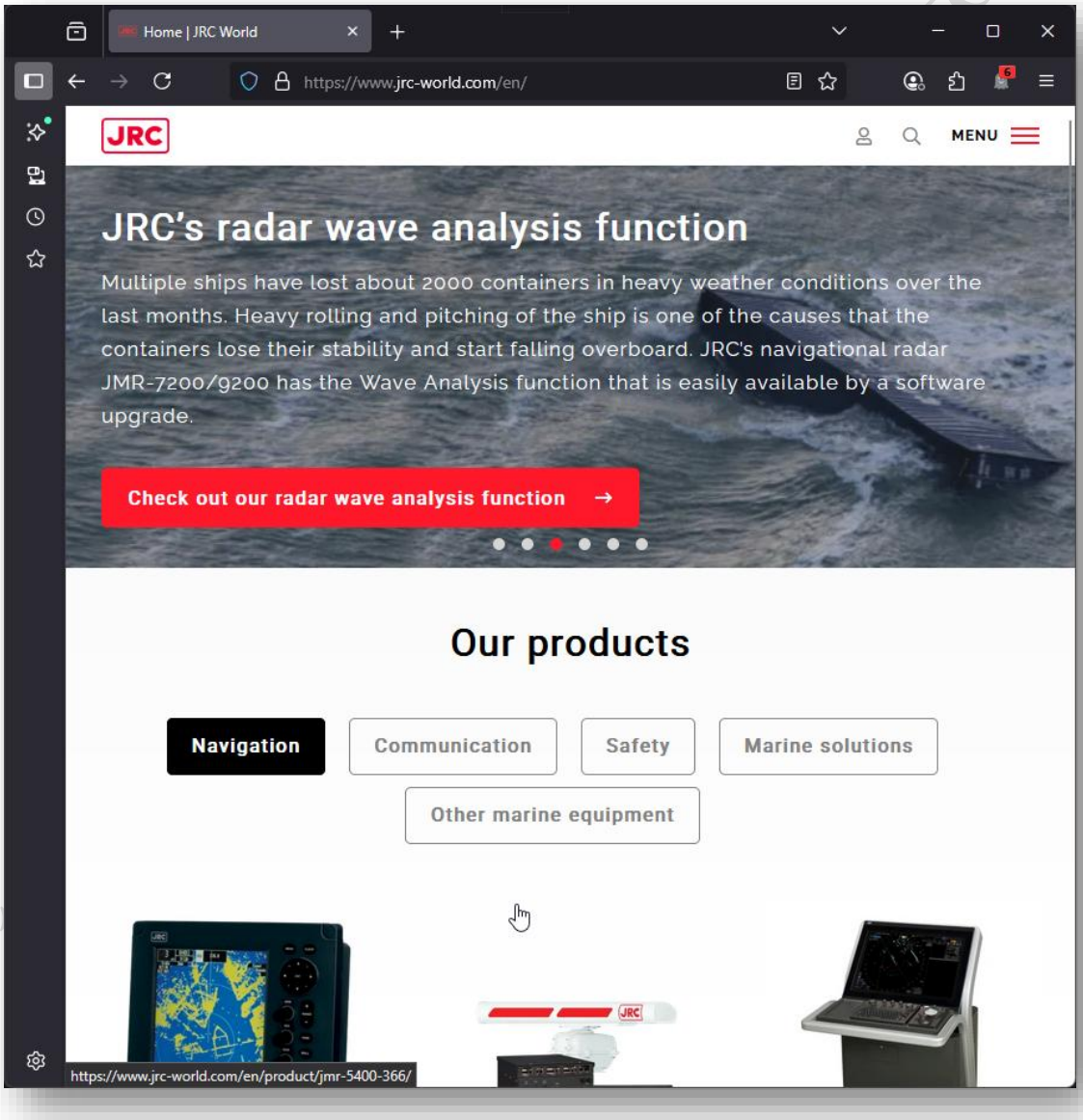
For the people that don't speak French here is the translation of the part of interest: "*The precision of the LASER changes depending on the distance. The greater the distance, the greater the impact of the Earth's curvature.*"

Flat Earth proponents should simply ask the manufacturer about their accumulated scientific and engineering knowledge rather than wasting time and money that could be better used trying to prove otherwise…

(#228) RADAR JRC (Japan Radio Co., Ltd.)

Japan Radio Co., Ltd. (JRC) is a Japanese company founded in 1915, specializing in the design and manufacture of electronic communication and navigation systems, primarily for the maritime sector. Globally recognized for the reliability of its equipment, JRC provides radars, GPS positioning systems, marine radios, and integrated solutions for ship safety and management. It also operates in the defense, aviation, and land-based telecommunications sectors, combining technological innovation with international standards. Through its global network of partners and distributors, JRC plays a key role in modernizing maritime infrastructure and global connectivity.

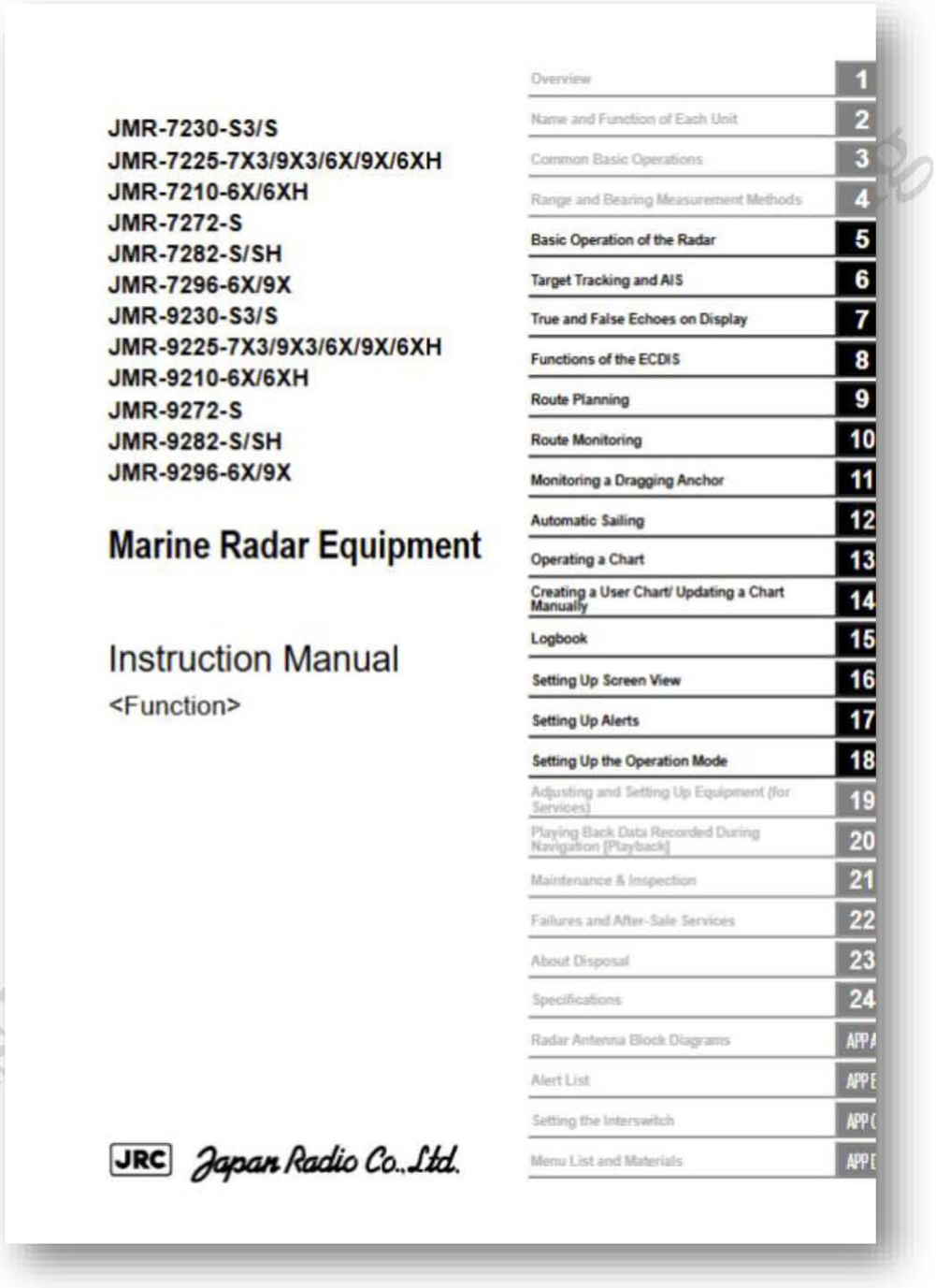
On its website Internet :


Home | JRC World
https://www.jrc-world.com/en/
JRC
MENU
JRC's radar wave analysis function
Multiple ships have lost about 2000 containers in heavy weather conditions over the last months. Heavy rolling and pitching of the ship is one of the causes that the containers lose their stability and start falling overboard. JRC's navigational radar JMR-7200/9200 has the Wave Analysis function that is easily available by a software upgrade.
Check out our radar wave analysis function →
Our products
Navigation
Communication
Safety
Marine solutions
Other marine equipment
https://www.jrc-world.com/en/product/jmr-5400-366/

Their catalogue can be downloaded for free here:

https://www.jrc-world.com/files/secured/sharepoint_documents/101-RadarSea+JRC+JMR-7200-9200+Instruct+Manual+Function+1-2-2022.pdf

The front cover of which is:



JMR-7230-S3/S
JMR-7225-7X3/9X3/6X/9X/6XH
JMR-7210-6X/6XH
JMR-7272-S
JMR-7282-S/SH
JMR-7296-6X/9X
JMR-9230-S3/S
JMR-9225-7X3/9X3/6X/9X/6XH
JMR-9210-6X/6XH
JMR-9272-S
JMR-9282-S/SH
JMR-9296-6X/9X

Marine Radar Equipment

Instruction Manual
<Function>

JRC Japan Radio Co.,Ltd.

Overview 1
Name and Function of Each Unit 2
Common Basic Operations 3
Range and Bearing Measurement Methods 4
Basic Operation of the Radar 5
Target Tracking and AIS 6
True and False Echoes on Display 7
Functions of the ECDIS 8
Route Planning 9
Route Monitoring 10
Monitoring a Dragging Anchor 11
Automatic Sailing 12
Operating a Chart 13
Creating a User Chart/ Updating a Chart Manually 14
Logbook 15
Setting Up Screen View 16
Setting Up Alerts 17
Setting Up the Operation Mode 18
Adjusting and Setting Up Equipment (for Services) 19
Playing Back Data Recorded During Navigation [Playback] 20
Maintenance & Inspection 21
Failures and After-Sale Services 22
About Disposal 23
Specifications 24
Radar Antenna Block Diagrams APP A
Alert List APP B
Setting the Interswitch APP C
Menu List and Materials APP D

And we have confirmation in section 7.1 that the curvature of the Earth is a parameter to be taken into account:

Section 7 True and False Echoes on Display

The radar operator has a role of interpreting the radar displays to provide his best aid in maneuvering the ship.

For this purpose, the operator has to observe the radar displays after fully understanding the advantages and disadvantages that the radar has.

For better interpretation of radar display, it is important to gain more experiences by operating the radar equipment in fair weathers and comparing the target ships watched with the naked eyes and their echoes on the radar display.

The radar is mainly used to monitor the courses of own ship and other ships in open seas, to check buoys and other nautical marks when entering a port, to measure own ship's position in the coastal waters relative to the bearings and ranges of the shore or islands using a chart, and to monitor the position and movement of a heavy rain if it appears on the radar display.

Various types of radar display are explained below.

7.1 Radar Wave with the Horizon

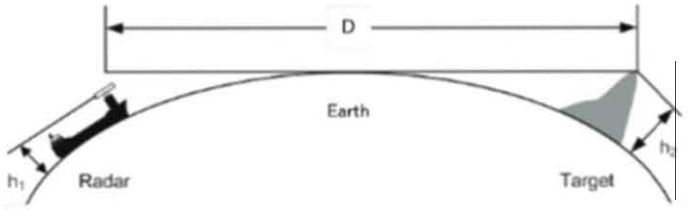
Radar beam radiation has the nature of propagating nearly along the curved surface of the earth. The propagation varies with the property of the air layer through which the radar beam propagates. In the normal propagation, the distance (D) of the radar wave to the horizon is approximately 10% longer than the distance to the optical horizon. The distance (D) is given by the following formula:

$D = 2.23(\sqrt{h_1} + \sqrt{h_2})$ (NM)

h_1: Height (m) of radar antenna above sea level

h_2: Height (m) of a target above sea level

The following figure illustrates a diagram for determining the maximum detection range of a target that is limited by the curve of the earth surface in the normal propagation.



Radar Wave with the Horizon

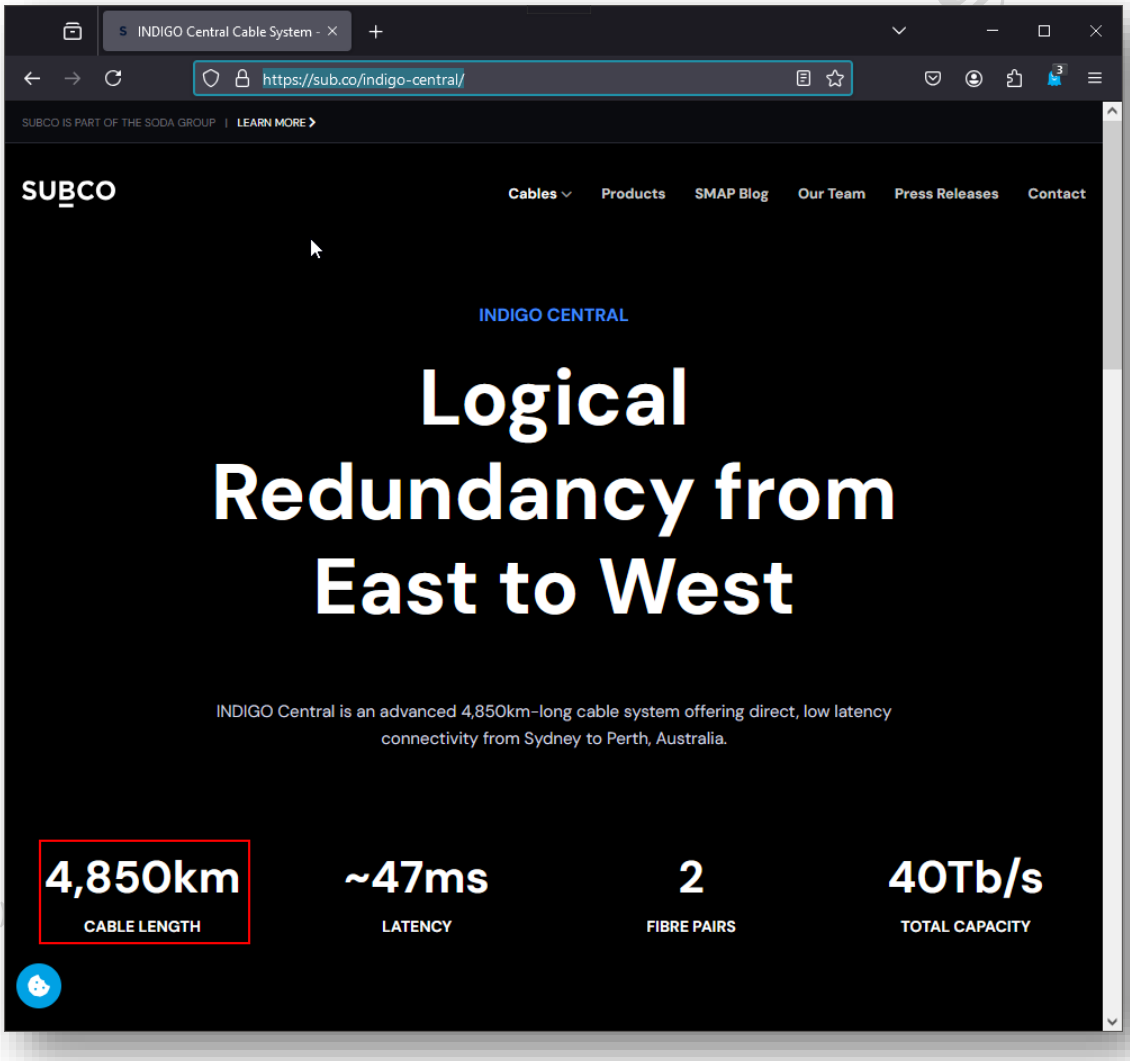
(#229) Submarine Optical fibers

Companies installing submarine copper or fiber optic cables must minimize the distance to optimize (minimize) costs.

The length of submarine cables is incompatible with a flat Earth. For example, the cable between Sydney and Perth, Australia, is 4,850 kilometers long according to its owners (Superloop, SingTel, Google, Indosat, Ooredoo, Aarnet) and follows the coastline. However, the shortest path on a flat Earth map is 8,300 kilometers between Sydney and Perth.

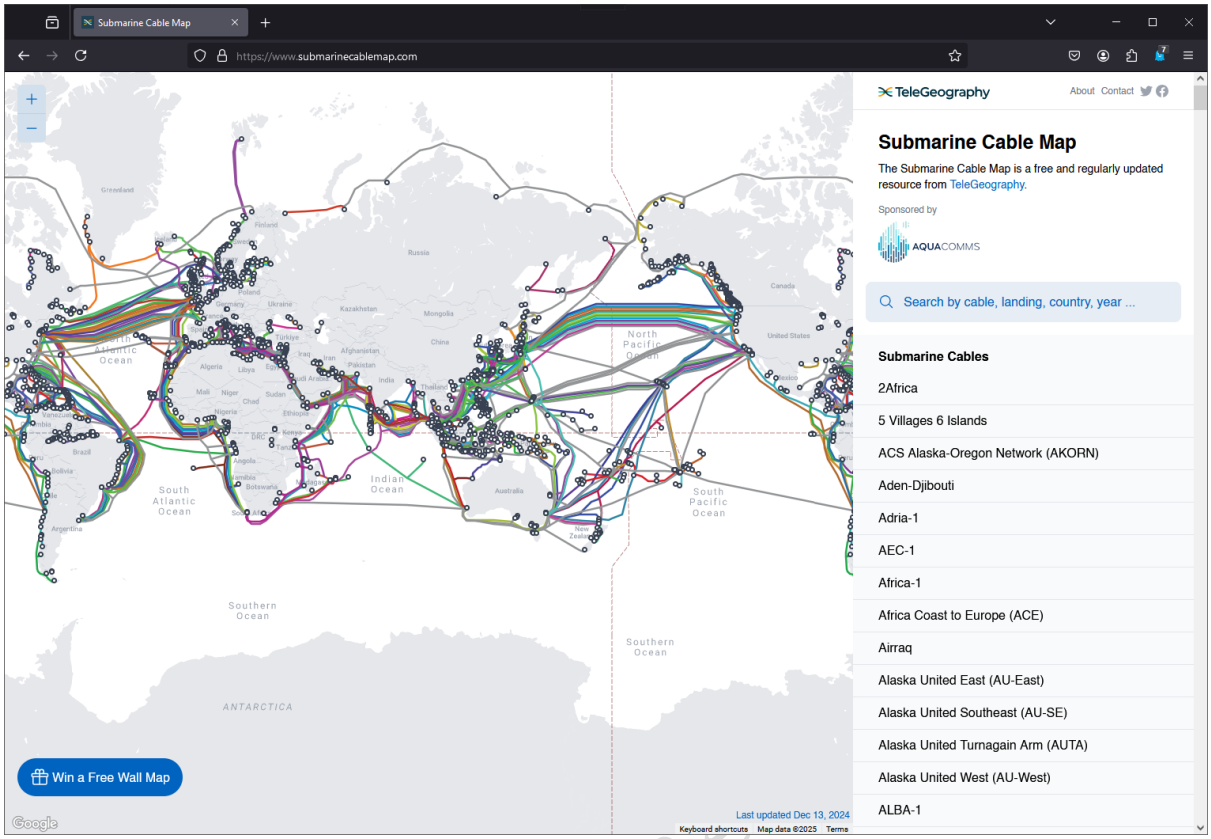
INDIGO Central is an advanced 4,850 km long cable system offering direct, low-latency connectivity from Sydney to Perth, Australia, as announced by the owning company:

https://sub.co/indigo-central/



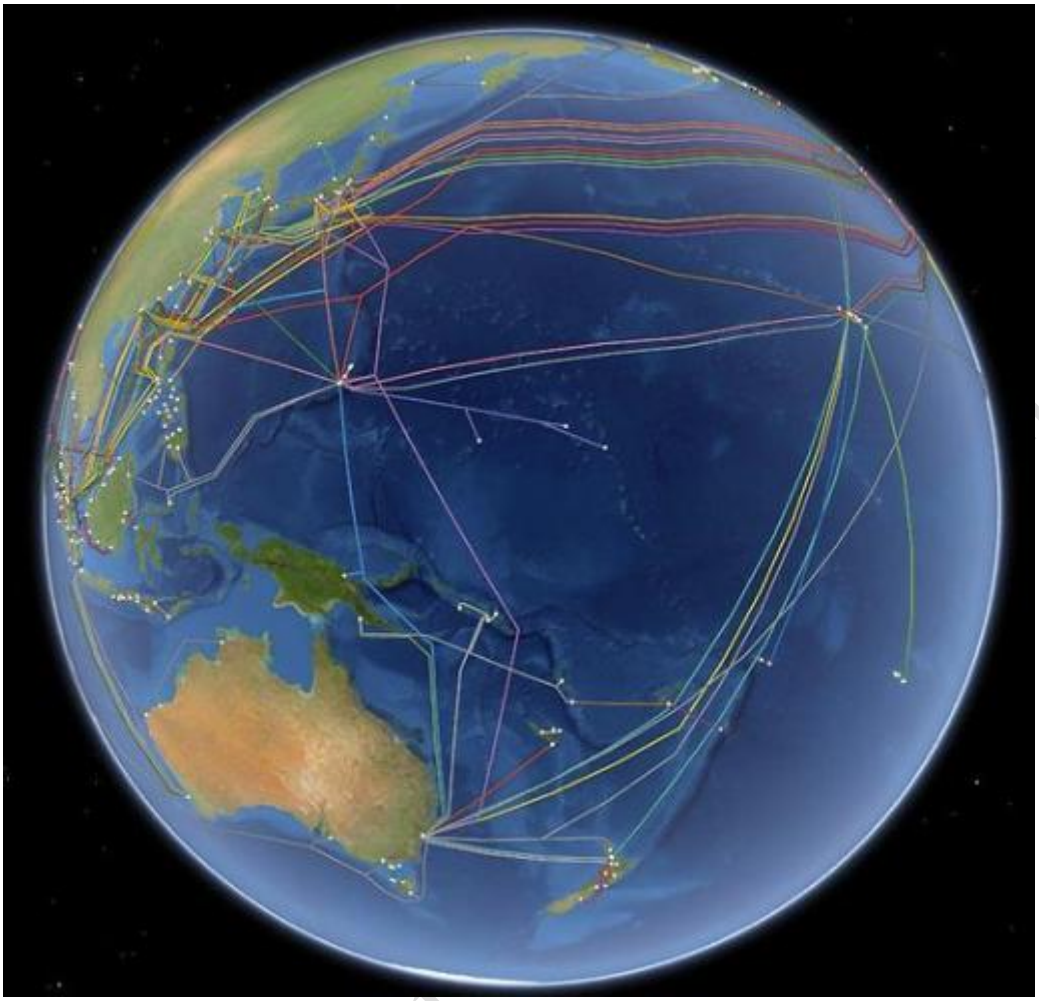
We can view all the fiber optic networks announced by private companies here:

https://www.submarinecablemap.com/submarine-cable/indigo-central



It is even possible to download a *.kml file for Google Earth showing the installed fiber optic cables:

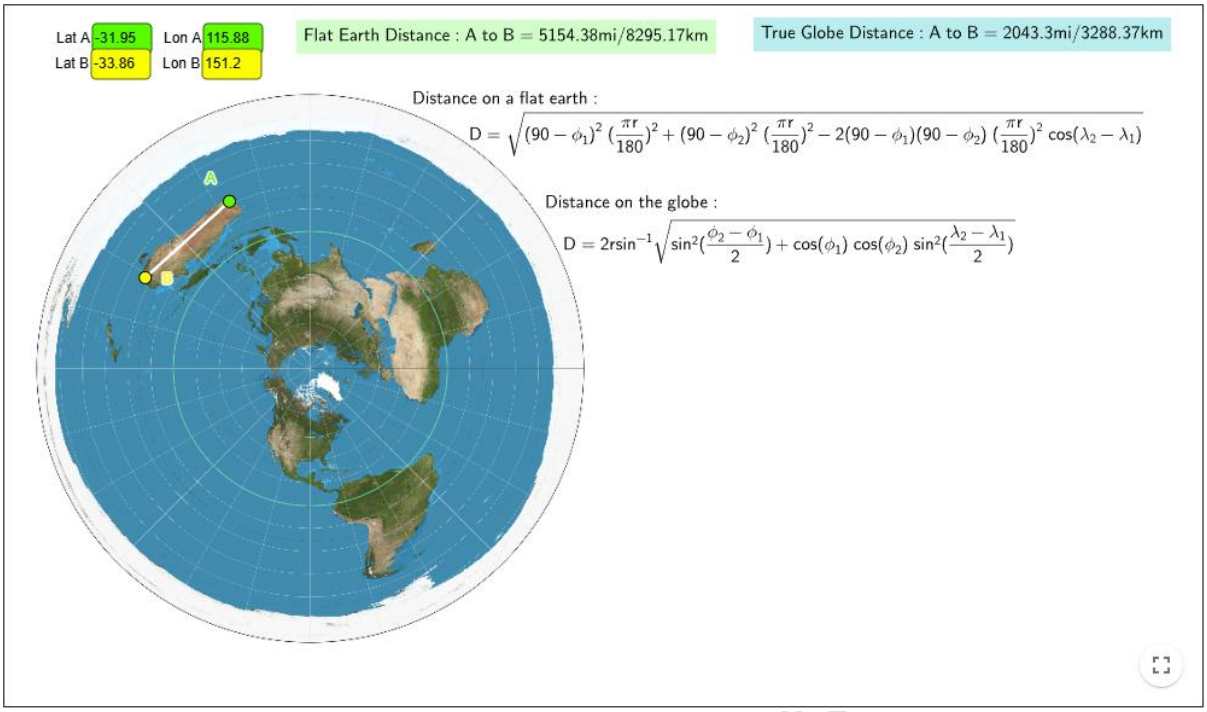
translation into en



Let's compare the distance on a flat Earth to check whether the distance is 4,850 kilometers or not:

https://www.geogebra.org/m/Ytxedv6s

translation in

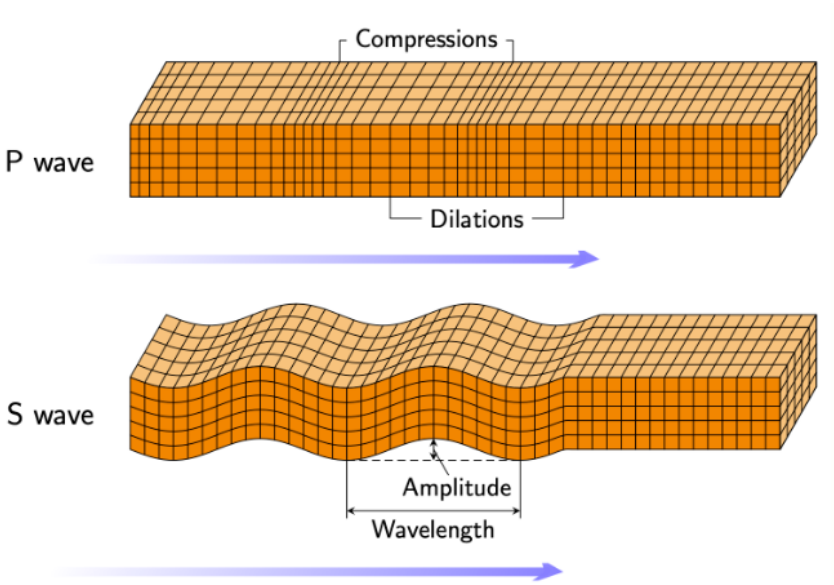

Lat A -31.95
Lon A 115.88
Lat B -33.86
Lon B 151.2
Flat Earth Distance : A to B = 5154.38mi/8295.17km
True Globe Distance : A to B = 2043.3mi/3288.37km
Distance on a flat earth :
$D = \sqrt{(90-\phi_1)^2 (\frac{\pi r}{180})^2 + (90-\phi_2)^2 (\frac{\pi r}{180})^2 - 2(90-\phi_1)(90-\phi_2) (\frac{\pi r}{180})^2 \cos(\lambda_2-\lambda_1)}$
Distance on the globe :
$D = 2r\sin^{-1}\sqrt{\sin^2(\frac{\phi_2-\phi_1}{2}) + \cos(\phi_1)\cos(\phi_2)\sin^2(\frac{\lambda_2-\lambda_1}{2})}$
A
B

So, yet another lie from the flat Earth proponents exposed!

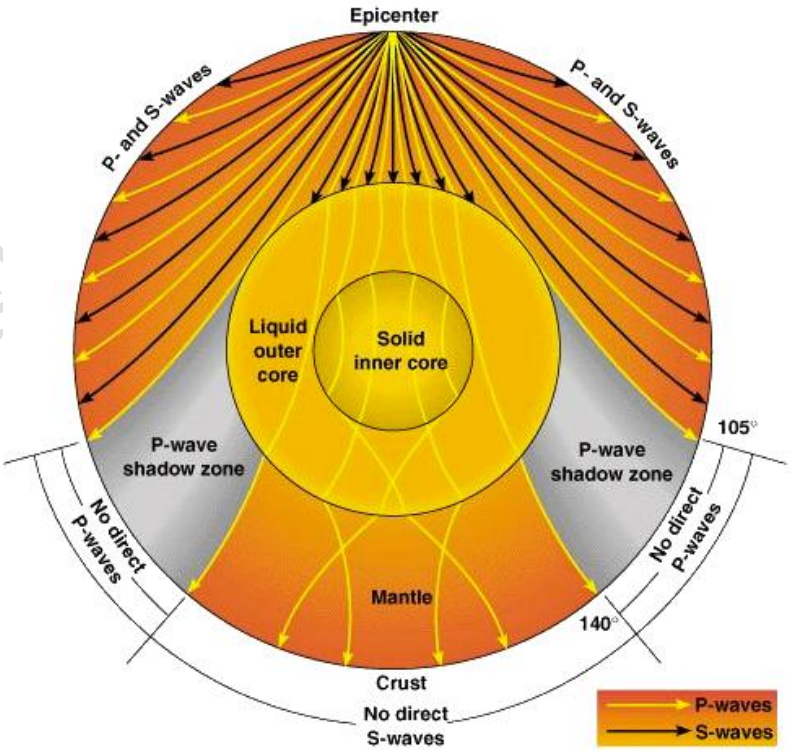
translation into engli

(#230) P and S seismic waves

The propagation of seismic waves (primary waves, secondary waves, Rayleigh waves, Love waves, Stoneley waves) after earthquakes is reflected and propagates in a way that would not work on a flat Earth.



The reflections of these seismic waves are in very good agreement with the oblate Earth model; conversely, no flat Earth model is compatible and able to explain the observations and measurements made in the field with seismographs.



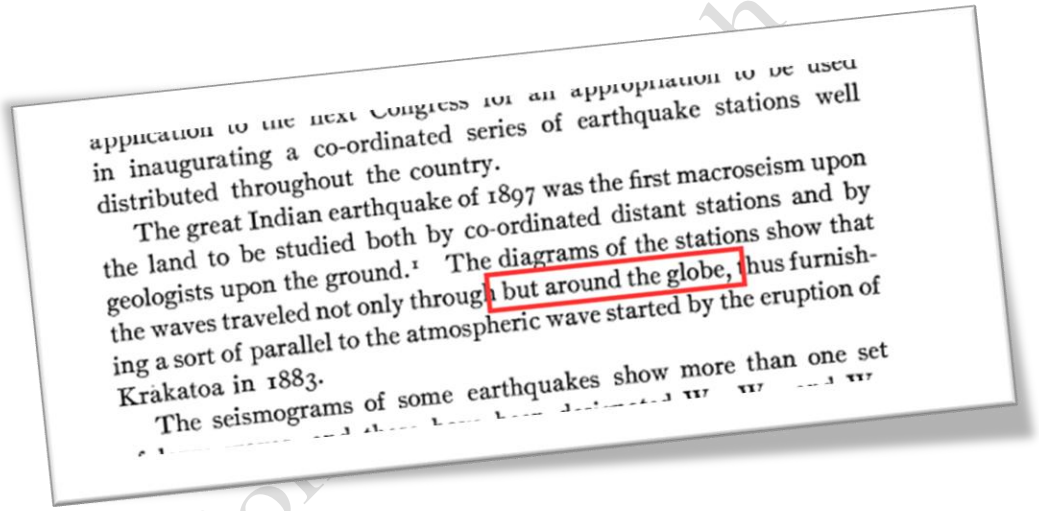
Here is the seismic wave equation and the corresponding propagation speed (Opera Magistris, 2024) :

$$\frac{\partial^2 y}{\partial t^2} = \frac{G}{\rho}\frac{\partial^2 y}{\partial x^2}$$

$$v = \sqrt{\frac{G}{\rho}}$$

There are many scientific articles that, through direct measurements, show that the Earth is a globe and not a disc. For example:

- (Global P wave tomography of Earth's lowermost mantle from partition modeling, 2013)
- (The Recent Advance in Seismology, 1907)



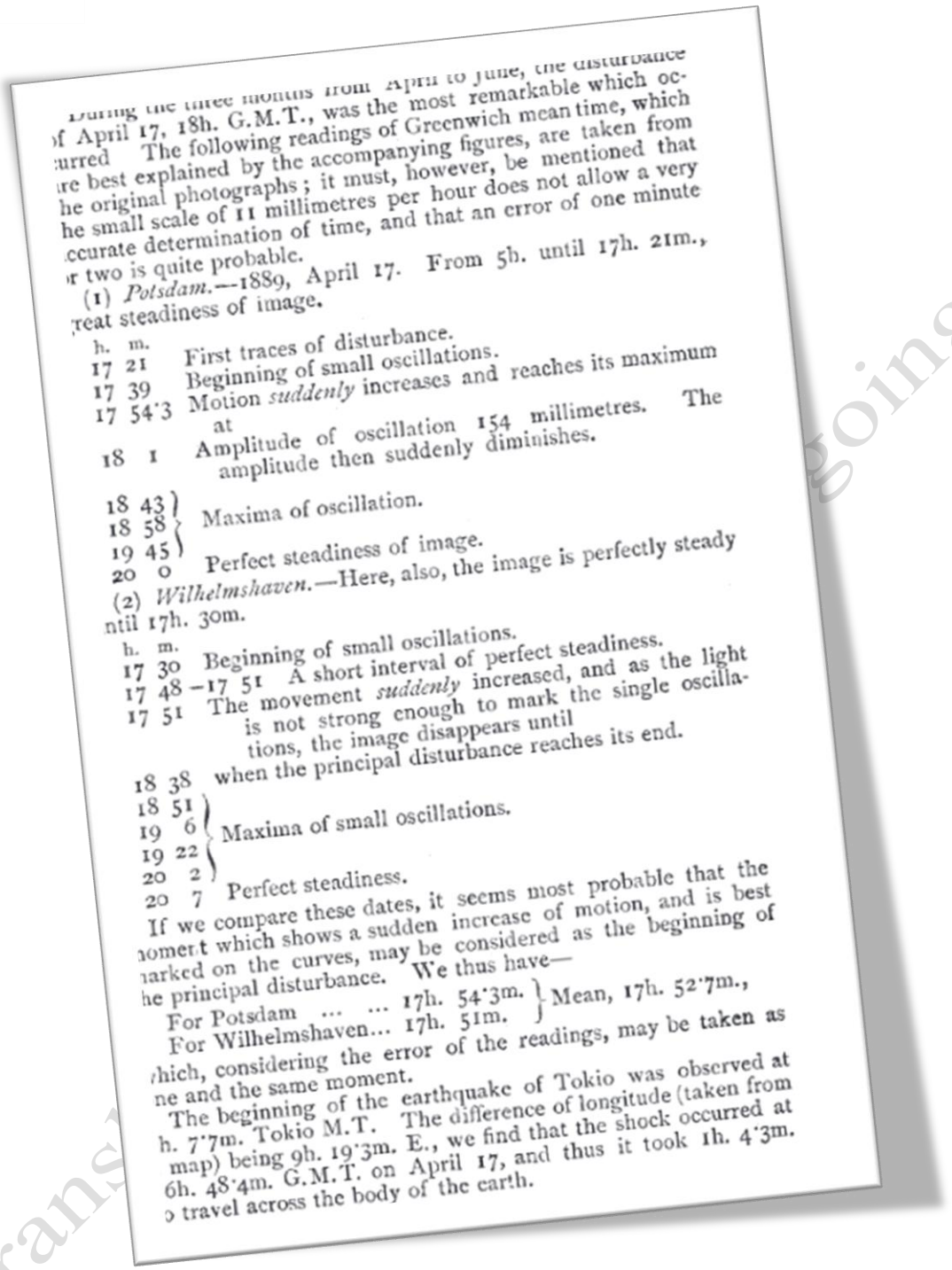
application to the next Congress for an appropriation to be used in inaugurating a co-ordinated series of earthquake stations well distributed throughout the country.

The great Indian earthquake of 1897 was the first macroseism upon the land to be studied both by co-ordinated distant stations and by geologists upon the ground.[1] The diagrams of the stations show that the waves traveled not only through but around the globe, thus furnishing a sort of parallel to the atmospheric wave started by the eruption of Krakatoa in 1883.

The seismograms of some earthquakes show more than one set

In 1889, Ernst von Rebeur Paschwitz (1861-1895) observed seismic waves in Germany originating from an earthquake that had occurred in Tokyo, Japan. It then became evident that a seismic shock could propagate through a spherical Earth as described and calculated in detail in (The earthquake of Tokio, April 18, 1889, 1889).

translation in progress ongoing



During the three months from April to June, the disturbance
of April 17, 18h. G.M.T., was the most remarkable which oc-
curred The following readings of Greenwich mean time, which
are best explained by the accompanying figures, are taken from
the original photographs; it must, however, be mentioned that
the small scale of 11 millimetres per hour does not allow a very
accurate determination of time, and that an error of one minute
or two is quite probable.

(1) *Potsdam.*—1889, April 17. From 5h. until 17h. 21m., great steadiness of image.

h.	m.	
17	21	First traces of disturbance.
17	39	Beginning of small oscillations.
17	54·3	Motion *suddenly* increases and reaches its maximum at
18	1	Amplitude of oscillation 154 millimetres. The amplitude then suddenly diminishes.
18	43	Maxima of oscillation.
18	58	
19	45	
20	0	Perfect steadiness of image.

(2) *Wilhelmshaven.*—Here, also, the image is perfectly steady until 17h. 30m.

h.	m.	
17	30	Beginning of small oscillations.
17	48–17	51 A short interval of perfect steadiness.
17	51	The movement *suddenly* increased, and as the light is not strong enough to mark the single oscillations, the image disappears until
18	38	when the principal disturbance reaches its end.
18	51	Maxima of small oscillations.
19	6	
19	22	
20	2	
20	7	Perfect steadiness.

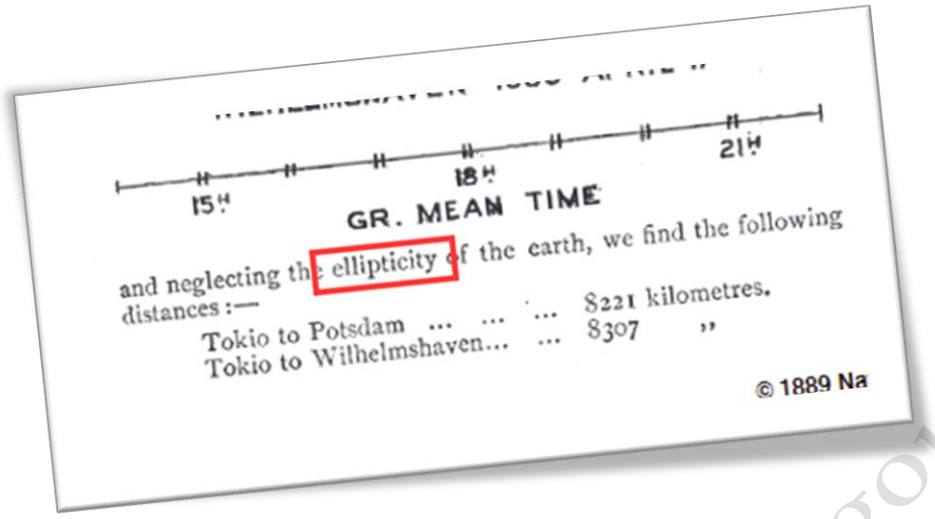
If we compare these dates, it seems most probable that the moment which shows a sudden increase of motion, and is best marked on the curves, may be considered as the beginning of the principal disturbance. We thus have—

For Potsdam ... ... 17h. 54·3m. } Mean, 17h. 52·7m.,
For Wilhelmshaven... 17h. 51m. }

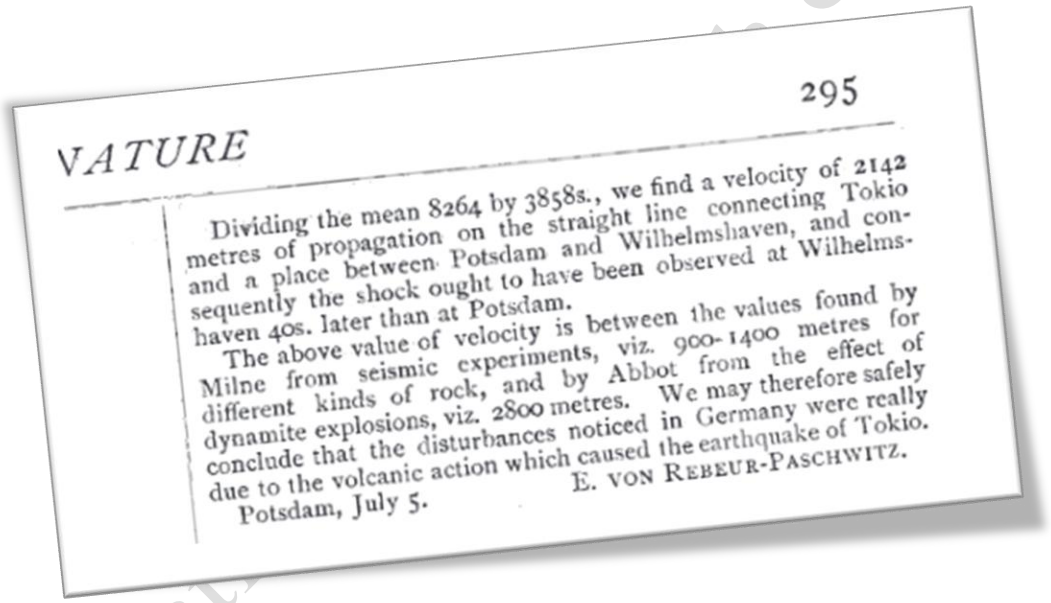
which, considering the error of the readings, may be taken as one and the same moment.

The beginning of the earthquake of Tokio was observed at 9h. 7·7m. Tokio M.T. The difference of longitude (taken from the map) being 9h. 19·3m. E., we find that the shock occurred at 6h. 48·4m. G.M.T. on April 17, and thus it took 1h. 4·3m. to travel across the body of the earth.

In this part of the article, we see that the author neglects the flattening of the sphere for the calculations that follow:

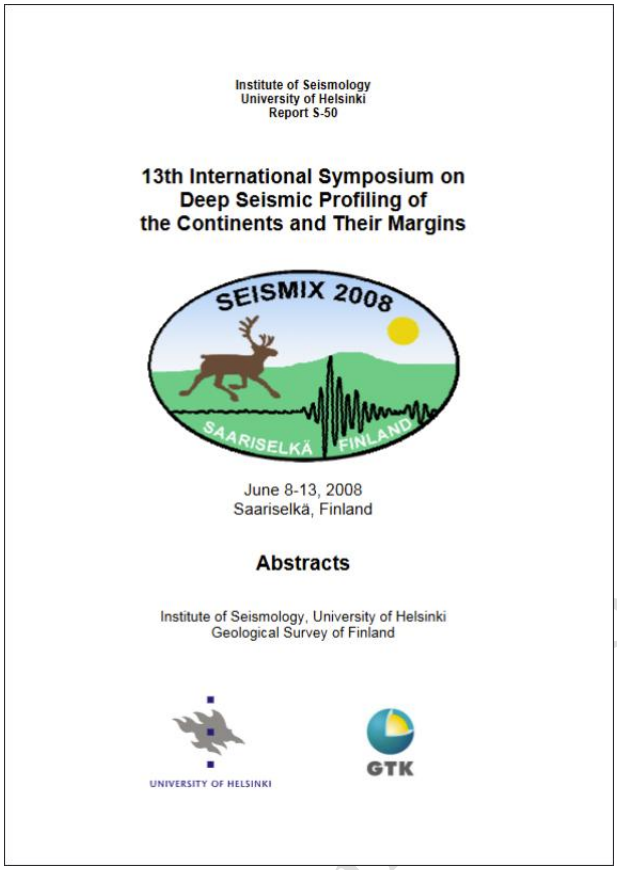

15H 18H 21H
GR. MEAN TIME
and neglecting the ellipticity of the earth, we find the following distances :—
Tokio to Potsdam ... ... 8221 kilometres.
Tokio to Wilhelmshaven... ... 8307 ,,
© 1889 Na

And the conclusion of the article:


NATURE 295
Dividing the mean 8264 by 3858s., we find a velocity of 2142 metres of propagation on the straight line connecting Tokio and a place between Potsdam and Wilhelmshaven, and consequently the shock ought to have been observed at Wilhelmshaven 40s. later than at Potsdam.
The above value of velocity is between the values found by Milne from seismic experiments, viz. 900-1400 metres for different kinds of rock, and by Abbot from the effect of dynamite explosions, viz. 2800 metres. We may therefore safely conclude that the disturbances noticed in Germany were really due to the volcanic action which caused the earthquake of Tokio.
Potsdam, July 5. E. VON REBEUR-PASCHWITZ.

We also have this document from the 13th International Symposium on Seismology and Deep Drilling which repeatedly confirms that the Earth is curved:

https://www.seismo.helsinki.fi/seismix/SEISMIX2008abstracts.pdf



Institute of Seismology
University of Helsinki
Report S-50

13th International Symposium on Deep Seismic Profiling of the Continents and Their Margins

SEISMIX 2008
SAARISELKÄ FINLAND

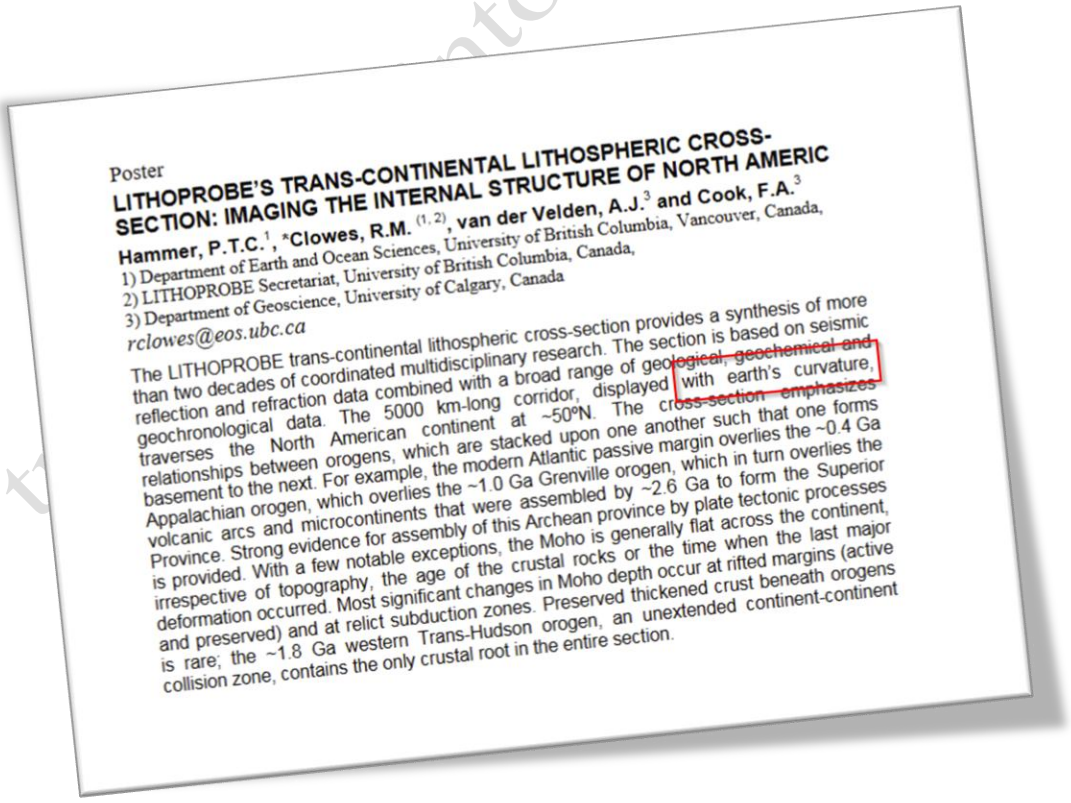
June 8-13, 2008
Saariselkä, Finland

Abstracts

Institute of Seismology, University of Helsinki
Geological Survey of Finland

UNIVERSITY OF HELSINKI
GTK

For example, on page 23:



Poster

LITHOPROBE'S TRANS-CONTINENTAL LITHOSPHERIC CROSS-SECTION: IMAGING THE INTERNAL STRUCTURE OF NORTH AMERIC

Hammer, P.T.C.[1], ***Clowes, R.M.**[1, 2], **van der Velden, A.J.**[3] **and Cook, F.A.**[3]
1) Department of Earth and Ocean Sciences, University of British Columbia, Vancouver, Canada,
2) LITHOPROBE Secretariat, University of British Columbia, Canada,
3) Department of Geoscience, University of Calgary, Canada
rclowes@eos.ubc.ca

The LITHOPROBE trans-continental lithospheric cross-section provides a synthesis of more than two decades of coordinated multidisciplinary research. The section is based on seismic reflection and refraction data combined with a broad range of geological, geochemical and geochronological data. The 5000 km-long corridor, displayed with earth's curvature, traverses the North American continent at ~50°N. The cross-section emphasizes relationships between orogens, which are stacked upon one another such that one forms basement to the next. For example, the modern Atlantic passive margin overlies the ~0.4 Ga Appalachian orogen, which overlies the ~1.0 Ga Grenville orogen, which in turn overlies the volcanic arcs and microcontinents that were assembled by ~2.6 Ga to form the Superior Province. Strong evidence for assembly of this Archean province by plate tectonic processes is provided. With a few notable exceptions, the Moho is generally flat across the continent, irrespective of topography, the age of the crustal rocks or the time when the last major deformation occurred. Most significant changes in Moho depth occur at rifted margins (active and preserved) and at relict subduction zones. Preserved thickened crust beneath orogens is rare; the ~1.8 Ga western Trans-Hudson orogen, an unextended continent-continent collision zone, contains the only crustal root in the entire section.

Coriolis effect (pseudo-force)

The Coriolis force is a fictitious inertial force acting perpendicularly to the direction of motion of a body moving in a medium (a frame of reference) that is itself rotating at a constant speed, as seen by an observer sharing the same frame of reference. This pseudo-force is named in honor of the French engineer Gaspard-Gustave Coriolis.

It can be shown that the pseudo-Coriolis force is given by (Opera Magistris, 2024):

$$\vec{F}_C = -2m\vec{\Omega} \times \vec{v} \coloneqq -m\vec{a}_c$$

Illustration of the Coriolis effect between the Northern and Southern Hemispheres in the ideal case (statistically, there are rare exceptions due to multifactorial reasons):

It is important to note that in the paradigm of flat Earth proponents, the Earth does not rotate on its axis because this would contradict several texts from several Abrahamic sects.

We will present here only the cases of the Coriolis effect that prove the Earth is oblate, and not the cases of the Coriolis effect that can only prove that the Earth rotates, such as:

- The fact that the army takes into account the Coriolis effect for intercontinental missiles and for long-range artillery fire.
- The fact that snipers take the Coriolis effect into account for their long-range shots.
- The fact that airliners have to slightly correct their trajectory during their flight because of the Coriolis effect.

translation in English ongoing

(#231) Coriolis effect on hurricanes

Below is a satellite animation showing the clockwise and counterclockwise movements of hurricanes and cyclones, which is clearly visible:

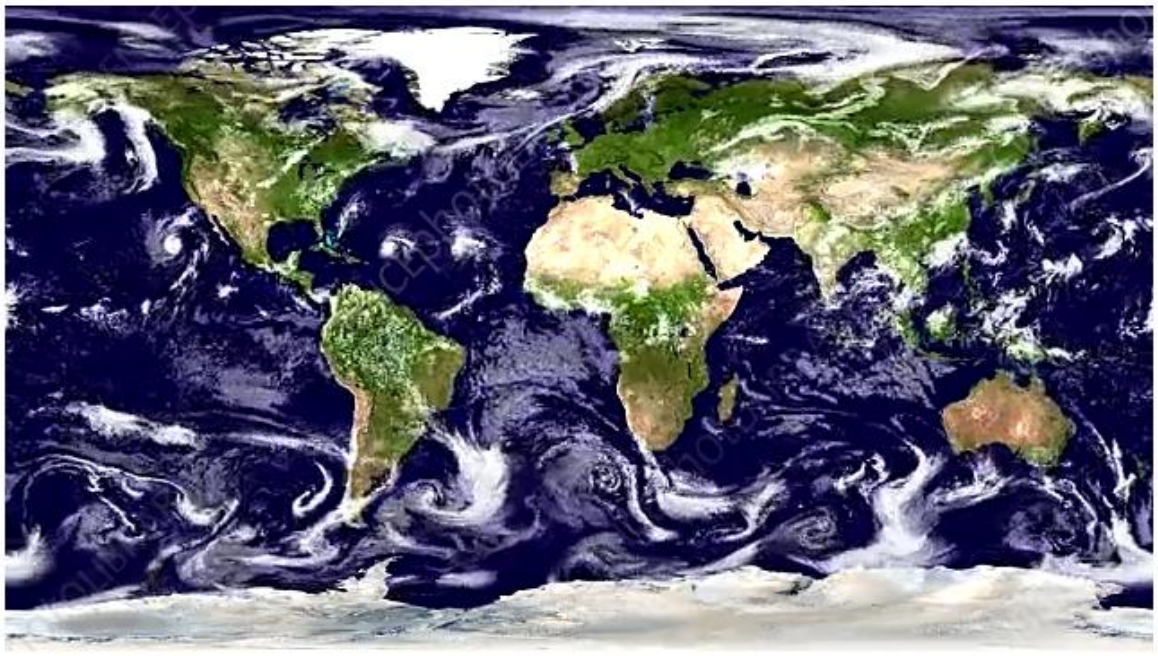
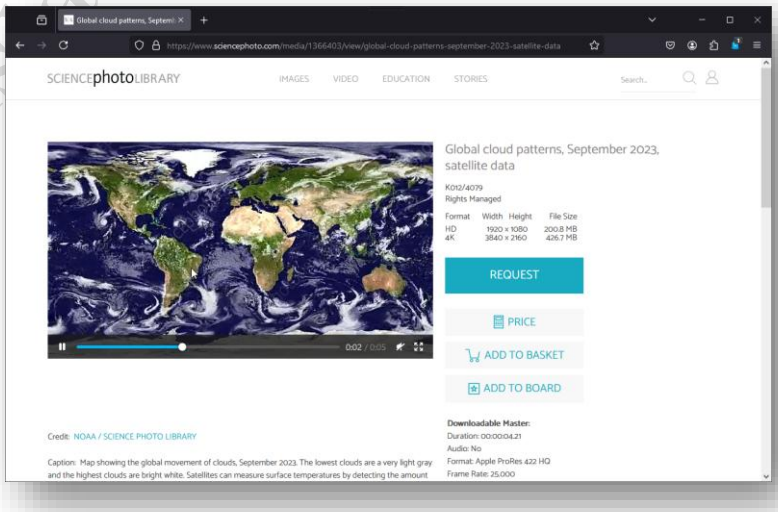


Figure 124 Map showing global cloud movement, September 2023 (source: NOAA / Science Photo Library)

The observation that hurricanes statistically respect the Coriolis effect the vast majority of the time is evidence that not only does the Earth rotate, but also that it is compatible with the sphere model.

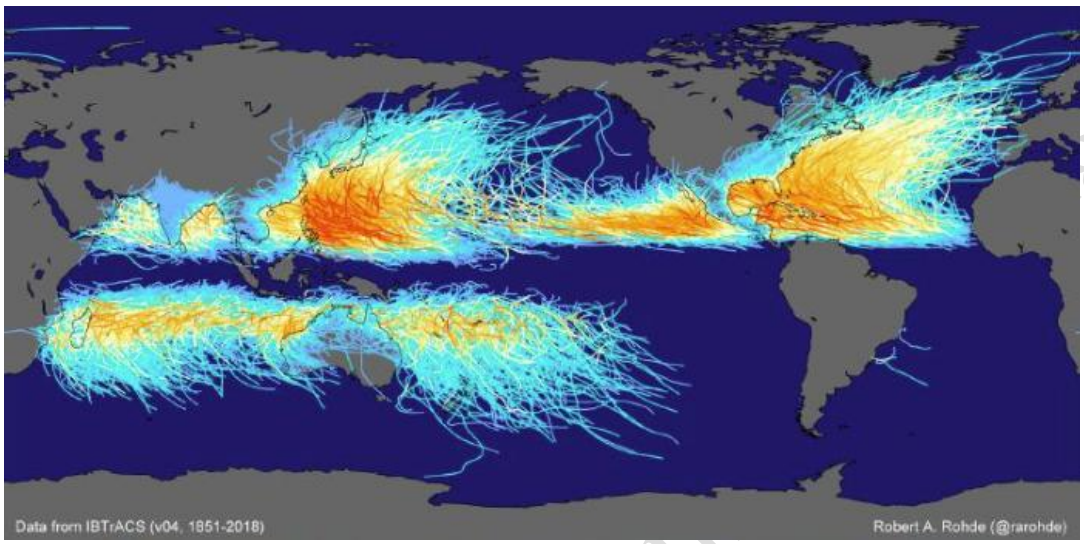
An animated version is available by following the link below:

https://www.sciencephoto.com/media/1366403/view/global-cloud-patterns-september-2023-satellite-data



(#232) Hurricane wall due to Coriolis effect

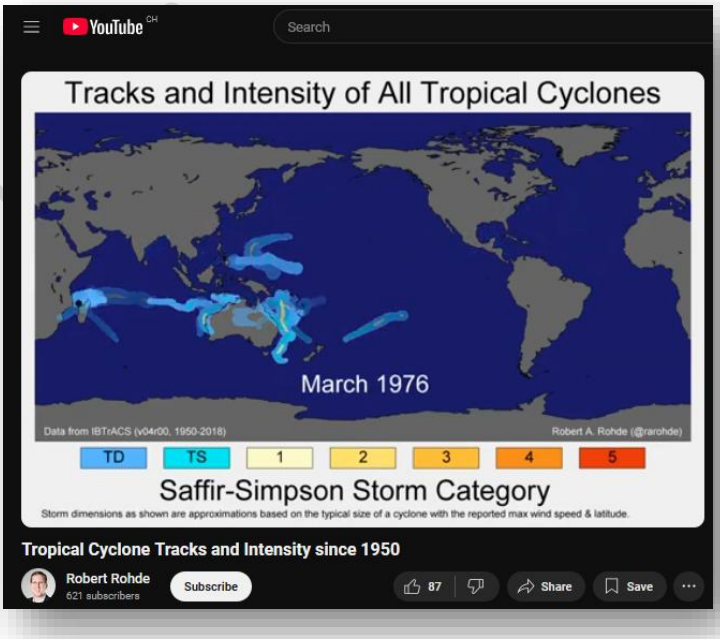
Also due to the Coriolis effect and because the Earth is a globe, no hurricane has been able to cross the equator since the history of recordings of their trajectories from January 1950 to July 2018:



Since the Coriolis effect is zero at the equator, this means there is no deviation in the storm's path. Consequently, any storm that approaches the equator will weaken and eventually dissipate. This is why no tropical cyclone or hurricane has ever crossed the equator!

If you're interested, here's a video for those who prefer to see the trajectories of hurricanes over the last 70 years in an animated way:

https://www.youtube.com/watch?v=lRCgxo_0I1Y



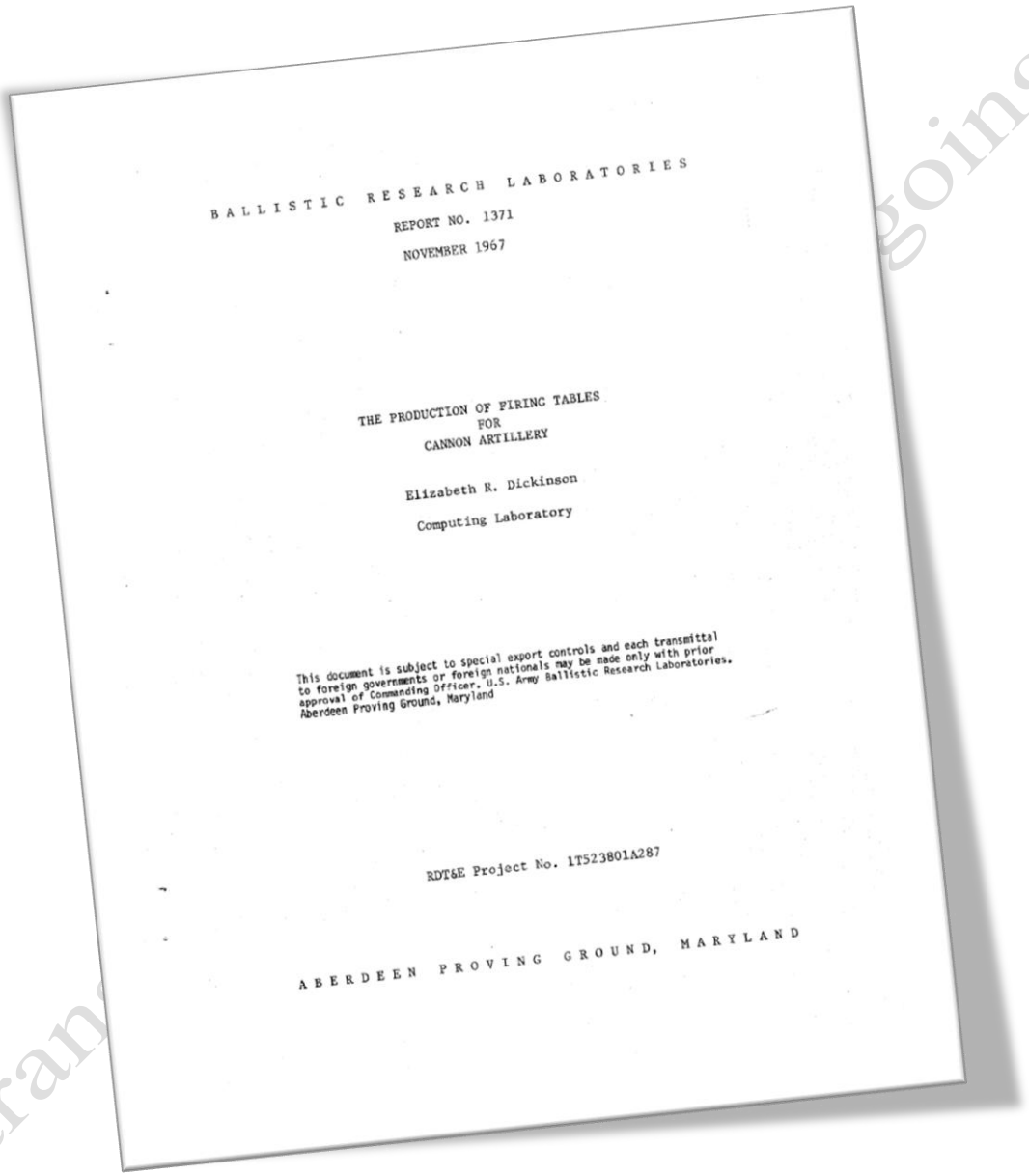
The data for the video were compiled by Robert Andrew Rohde, an American physicist and former graduate student of the University of California, Berkeley, where he studied under Richard A. Muller. He received his PhD in 2010 with a thesis entitled "*The Development and Use of the Berkeley Fluorescence Spectrometer to Characterize Microbial Content and Detect Volcanic Ash in Glacial Ice.*"

translation into english ongoing

(#233) Coriolis effect on long-range ballistic shots

The US military, for its long-range ballistic missile tests, must take into account the Coriolis effect, as indicated in the 1967 report from the Ballistic Research Laboratory in Maryland (USA), available here:

https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/AD826735.xhtml#



BALLISTIC RESEARCH LABORATORIES

REPORT NO. 1371

NOVEMBER 1967

THE PRODUCTION OF FIRING TABLES
FOR
CANNON ARTILLERY

Elizabeth R. Dickinson

Computing Laboratory

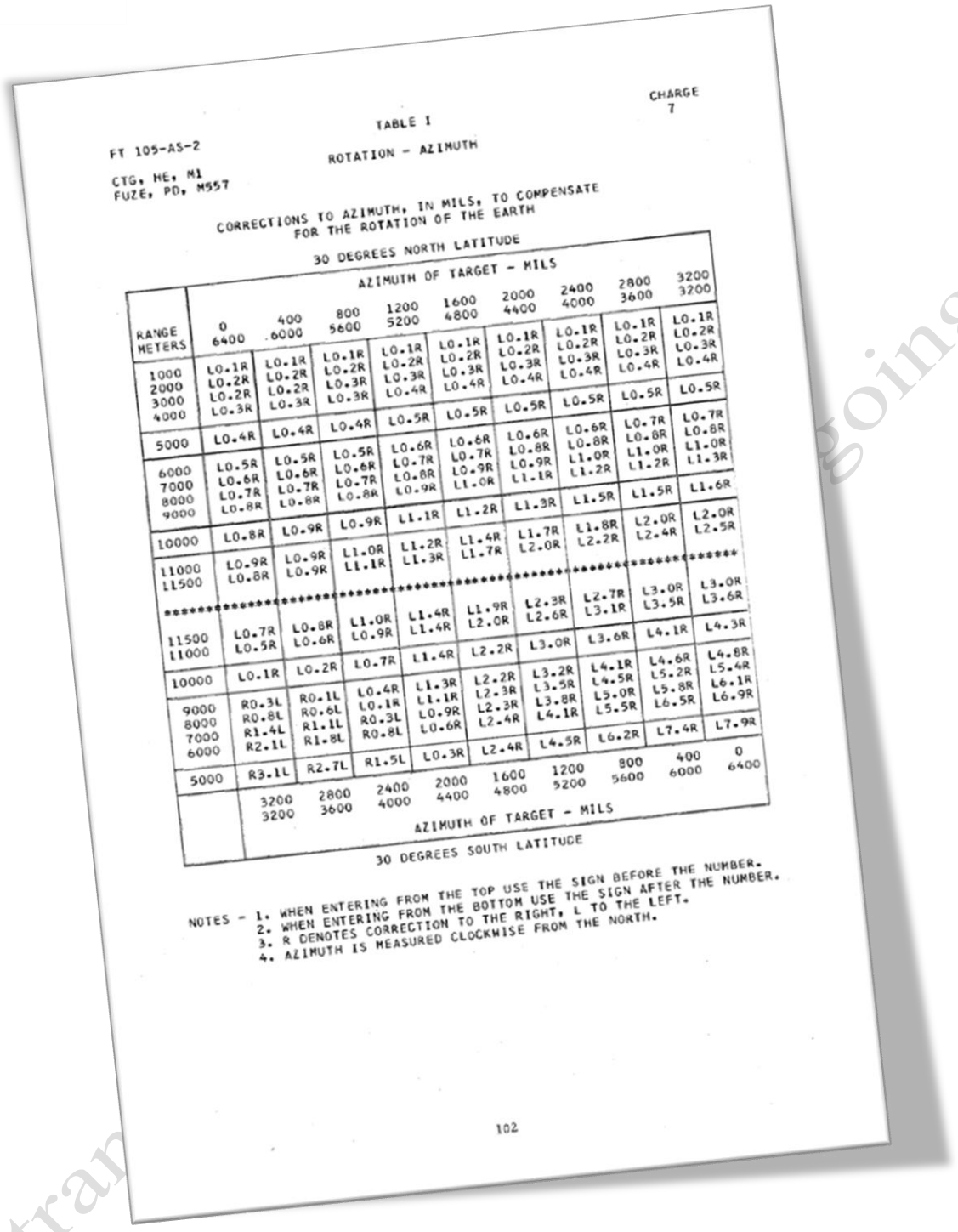
This document is subject to special export controls and each transmittal to foreign governments or foreign nationals may be made only with prior approval of Commanding Officer, U.S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland

RDT&E Project No. 1T523801A287

ABERDEEN PROVING GROUND, MARYLAND

going

However, knowing that the military takes the Coriolis effect into account is not in itself proof that the Earth is spherical. What is proof, however, is the table on page 102 of the same report:



FT 105-AS-2 CHARGE 7

TABLE I

CTG, HE, M1
FUZE, PD, M557

ROTATION - AZIMUTH

CORRECTIONS TO AZIMUTH, IN MILS, TO COMPENSATE FOR THE ROTATION OF THE EARTH

30 DEGREES NORTH LATITUDE

RANGE METERS	AZIMUTH OF TARGET - MILS								
	0 6400	400 6000	800 5600	1200 5200	1600 4800	2000 4400	2400 4000	2800 3600	3200 3200
1000 2000 3000 4000	L0.1R L0.2R L0.2R L0.3R	L0.1R L0.2R L0.2R L0.3R	L0.1R L0.2R L0.3R L0.3R	L0.1R L0.2R L0.3R L0.4R	L0.1R L0.2R L0.3R L0.4R	L0.1R L0.2R L0.3R L0.4R	L0.1R L0.2R L0.3R L0.4R	L0.1R L0.2R L0.3R L0.4R	L0.1R L0.2R L0.3R L0.4R
5000	L0.4R	L0.4R	L0.4R	L0.5R	L0.5R	L0.5R	L0.5R	L0.5R	L0.5R
6000 7000 8000 9000	L0.5R L0.6R L0.7R L0.8R	L0.5R L0.6R L0.7R L0.8R	L0.5R L0.6R L0.7R L0.8R	L0.6R L0.7R L0.8R L0.9R	L0.6R L0.7R L0.9R L1.0R	L0.6R L0.8R L0.9R L1.1R	L0.6R L0.8R L1.0R L1.2R	L0.7R L0.8R L1.0R L1.2R	L0.7R L0.8R L1.0R L1.3R
10000	L0.8R	L0.9R	L0.9R	L1.1R	L1.2R	L1.3R	L1.5R	L1.5R	L1.6R
11000 11500	L0.9R L0.8R	L0.9R L0.9R	L1.0R L1.1R	L1.2R L1.3R	L1.4R L1.7R	L1.7R L2.0R	L1.8R L2.2R	L2.0R L2.4R	L2.0R L2.5R
******									
11500 11000	L0.7R L0.5R	L0.8R L0.6R	L1.0R L0.9R	L1.4R L1.4R	L1.9R L2.0R	L2.3R L2.6R	L2.7R L3.1R	L3.0R L3.5R	L3.0R L3.6R
10000	L0.1R	L0.2R	L0.7R	L1.4R	L2.2R	L3.0R	L3.6R	L4.1R	L4.3R
9000 8000 7000 6000	R0.3L R0.8L R1.4L R2.1L	R0.1L R0.6L R1.1L R1.8L	L0.4R L0.1R R0.3L R0.8L	L1.3R L1.1R L0.9R L0.6R	L2.2R L2.3R L2.3R L2.4R	L3.2R L3.5R L3.8R L4.1R	L4.1R L4.5R L5.0R L5.5R	L4.6R L5.2R L5.8R L6.5R	L4.8R L5.4R L6.1R L6.9R
5000	R3.1L	R2.7L	R1.5L	L0.3R	L2.4R	L4.5R	L6.2R	L7.4R	L7.9R
	3200 3200	2800 3600	2400 4000	2000 4400	1600 4800	1200 5200	800 5600	400 6000	0 6400

AZIMUTH OF TARGET - MILS

30 DEGREES SOUTH LATITUDE

NOTES - 1. WHEN ENTERING FROM THE TOP USE THE SIGN BEFORE THE NUMBER.
2. WHEN ENTERING FROM THE BOTTOM USE THE SIGN AFTER THE NUMBER.
3. R DENOTES CORRECTION TO THE RIGHT, L TO THE LEFT.
4. AZIMUTH IS MEASURED CLOCKWISE FROM THE NORTH.

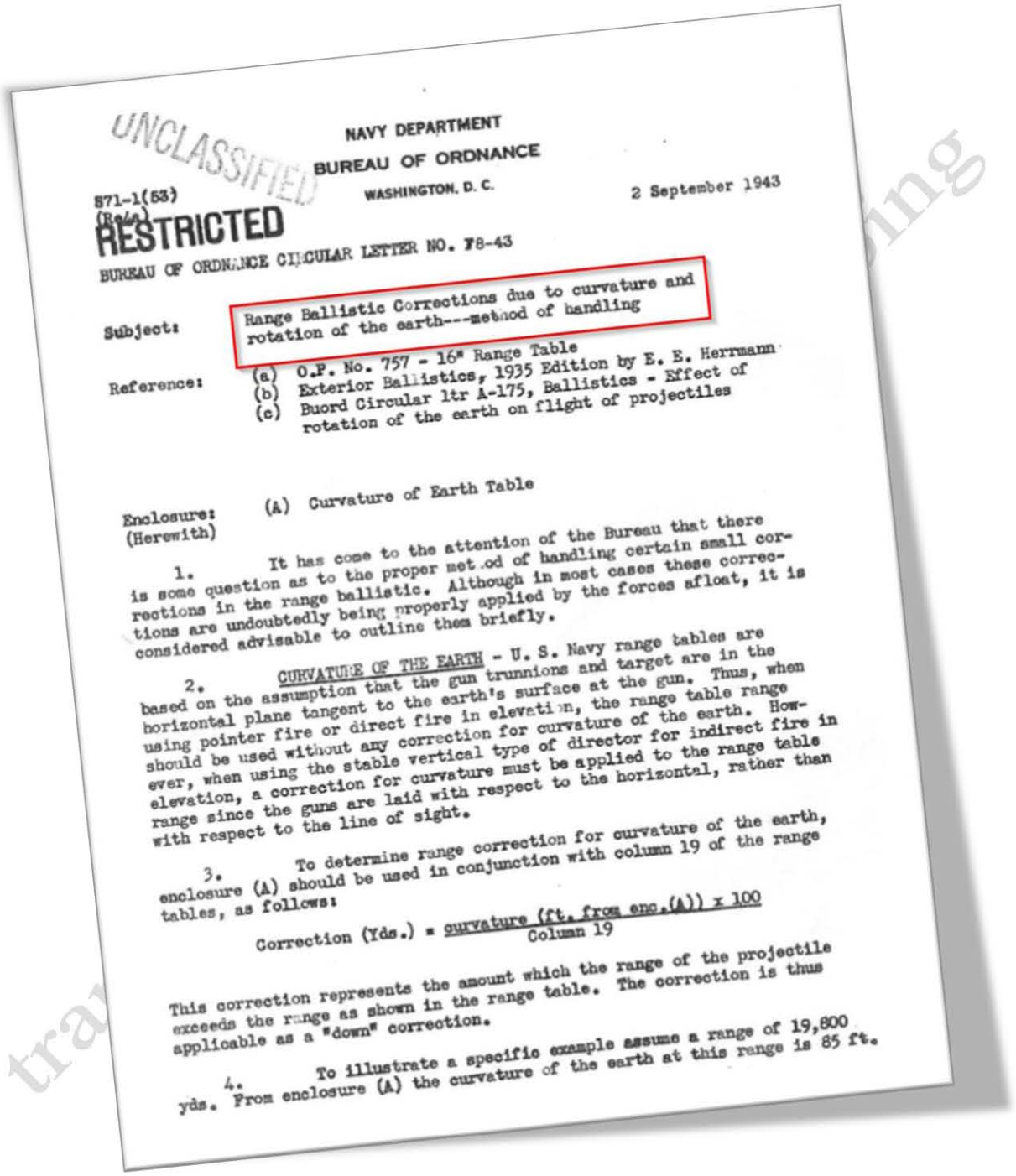
102

Where the upper part of the table is for a latitude of 30 degrees North and the lower part for a latitude of 30 degrees South (separated by ******). Since the **L** and **R** next to the numbers indicate the left and right corrections from the Northern and Southern Hemispheres respectively, we can see that it is indeed symmetrical (except for a few values over short distances, probably due to the spin of the projectile), and therefore this is proof that the Earth is a sphere!

There are many documents of the same kind from the army, such as this one:

https://mctoon.net/wp-content/uploads/2021/03/op-770-range-tables-for-16inch-50-caliber-gun-1.pdf

Where here again… Everything has been said:



UNCLASSIFIED

NAVY DEPARTMENT
BUREAU OF ORDNANCE
WASHINGTON, D. C.

S71-1(53)
(Re/a)
RESTRICTED

2 September 1943

BUREAU OF ORDNANCE CIRCULAR LETTER NO. 78-43

Subject: Range Ballistic Corrections due to curvature and rotation of the earth---method of handling

Reference:
(a) O.P. No. 757 - 16" Range Table
(b) Exterior Ballistics, 1935 Edition by E. E. Herrmann
(c) Buord Circular ltr A-175, Ballistics - Effect of rotation of the earth on flight of projectiles

Enclosure: (A) Curvature of Earth Table
(Herewith)

1. It has come to the attention of the Bureau that there is some question as to the proper method of handling certain small corrections in the range ballistic. Although in most cases these corrections are undoubtedly being properly applied by the forces afloat, it is considered advisable to outline them briefly.

2. CURVATURE OF THE EARTH - U. S. Navy range tables are based on the assumption that the gun trunnions and target are in the horizontal plane tangent to the earth's surface at the gun. Thus, when using pointer fire or direct fire in elevation, the range table range should be used without any correction for curvature of the earth. However, when using the stable vertical type of director for indirect fire in elevation, a correction for curvature must be applied to the range table range since the guns are laid with respect to the horizontal, rather than with respect to the line of sight.

3. To determine range correction for curvature of the earth, enclosure (A) should be used in conjunction with column 19 of the range tables, as follows:

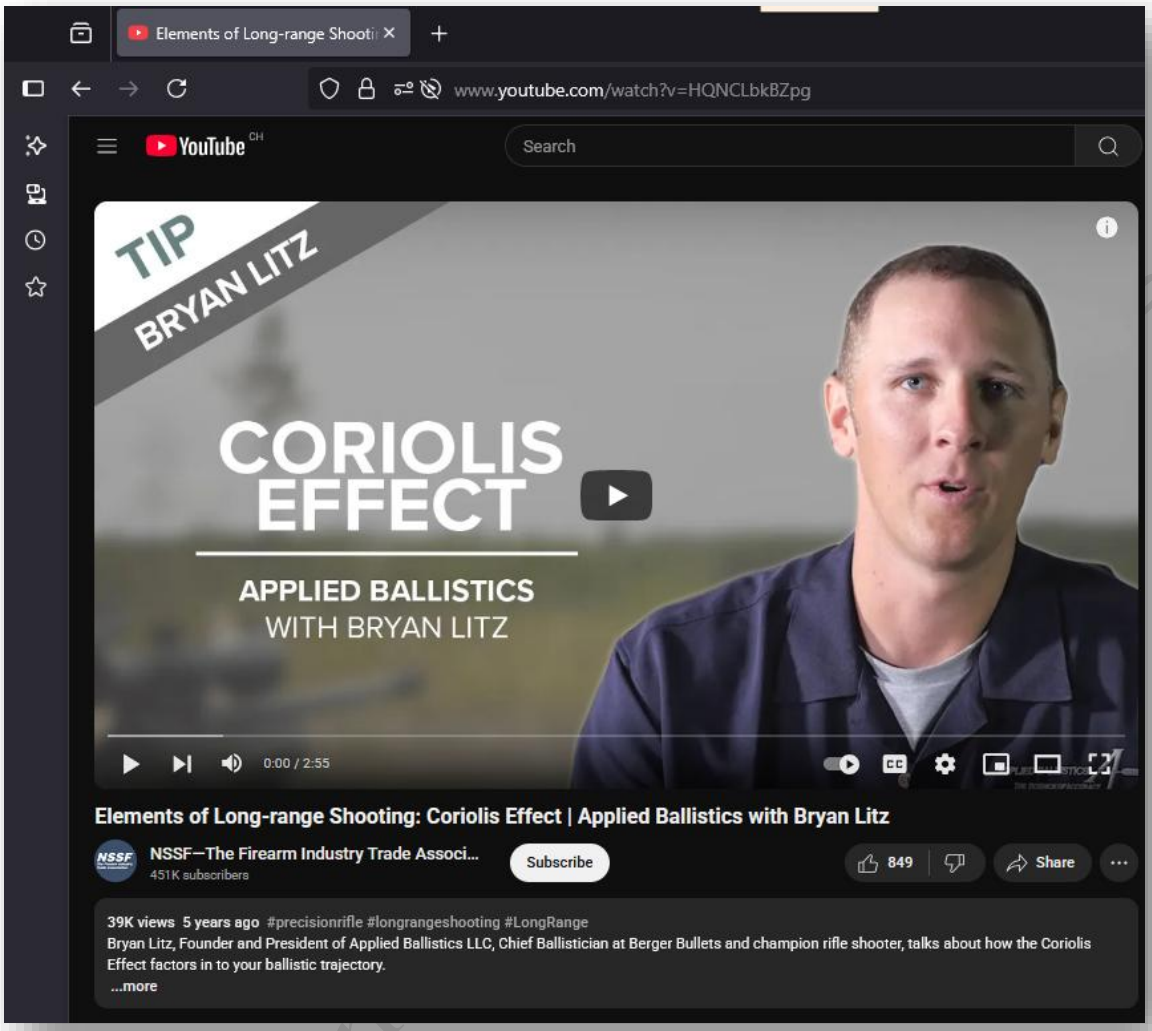
$$\text{Correction (Yds.)} = \frac{\text{curvature (ft. from enc.(A))} \times 100}{\text{Column 19}}$$

This correction represents the amount which the range of the projectile exceeds the range as shown in the range table. The correction is thus applicable as a "down" correction.

4. To illustrate a specific example assume a range of 19,800 yds. From enclosure (A) the curvature of the earth at this range is 85 ft.

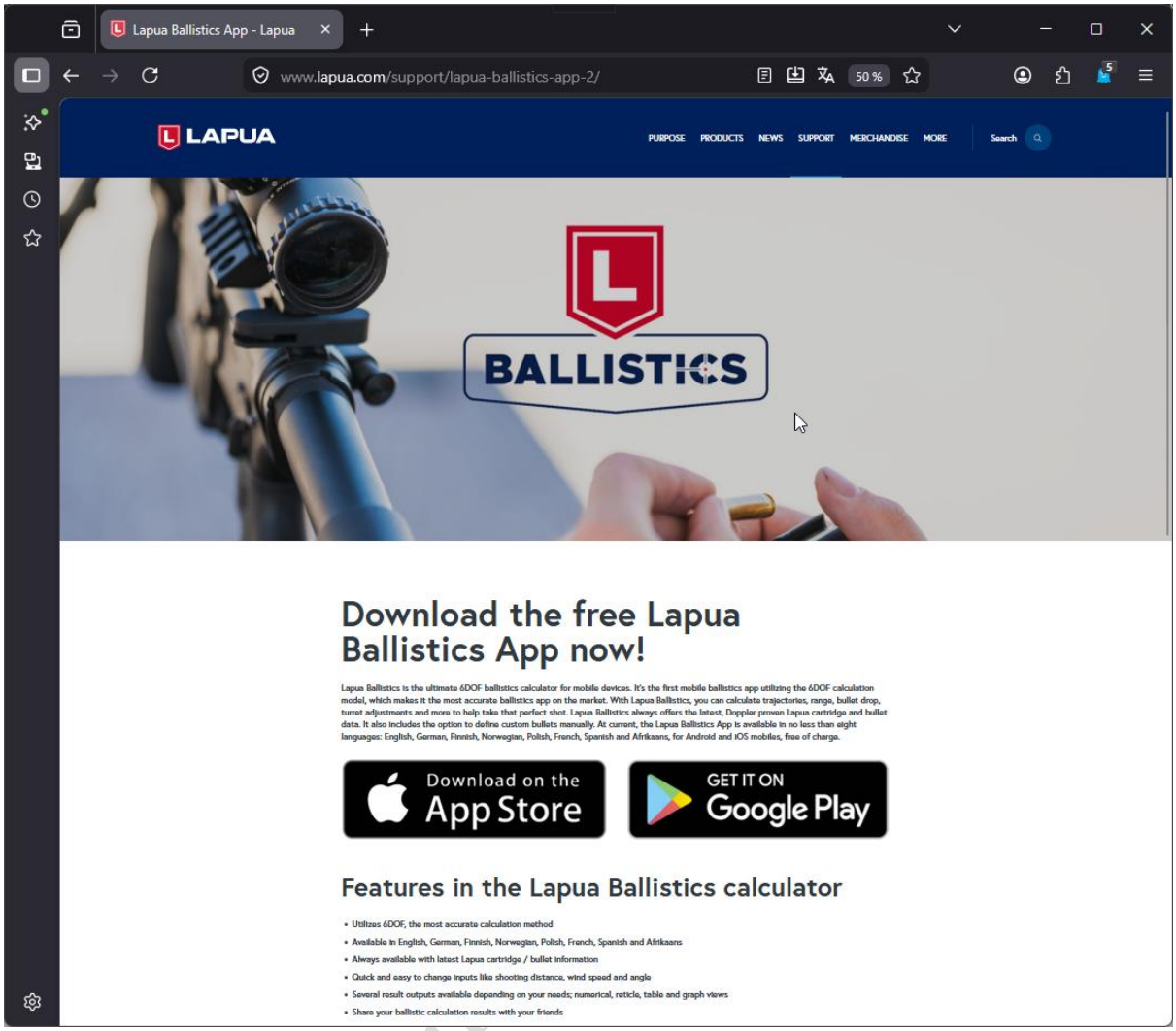
Or this video where a ballistics specialist from the American professional association of the firearms industry confirms that in certain specific cases the Coriolis effect must be taken into account:

https://www.youtube.com/watch?v=HQNCLbkBZpg


Elements of Long-range Shooti
www.youtube.com/watch?v=HQNCLbkBZpg
YouTube CH
Search
TIP
BRYAN LITZ
CORIOLIS EFFECT
APPLIED BALLISTICS
WITH BRYAN LITZ
0:00 / 2:55
Elements of Long-range Shooting: Coriolis Effect | Applied Ballistics with Bryan Litz
NSSF—The Firearm Industry Trade Associ...
451K subscribers
Subscribe
849
Share
39K views 5 years ago #precisionrifle #longrangeshooting #LongRange
Bryan Litz, Founder and President of Applied Ballistics LLC, Chief Ballistician at Berger Bullets and champion rifle shooter, talks about how the Coriolis Effect factors in to your ballistic trajectory.
...more

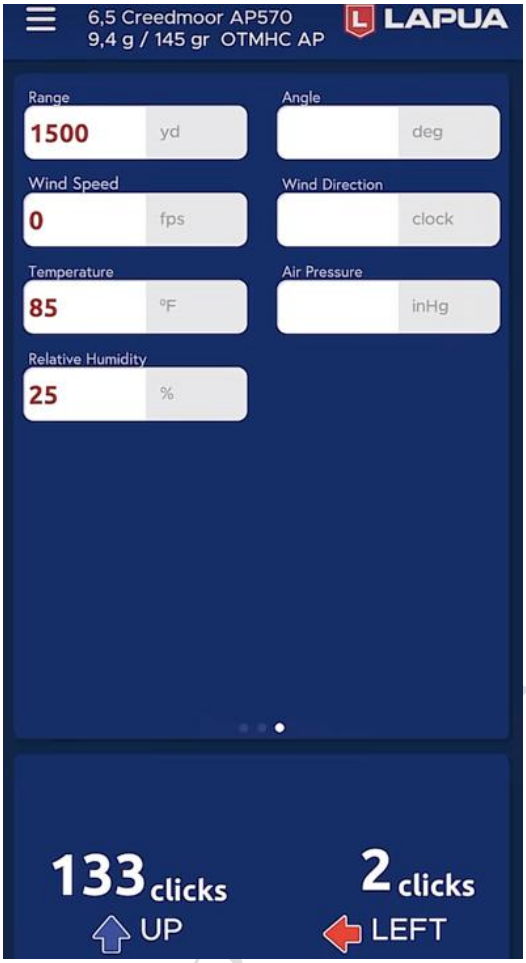
The reader can also take as an example the smartphone application used by many amateur and professional sport shooters and even some elite shooters, such as Lapua Ballistics:

translation


Lapua Ballistics App - Lapua
www.lapua.com/support/lapua-ballistics-app-2/
50 %
LAPUA
PURPOSE
PRODUCTS
NEWS
SUPPORT
MERCHANDISE
MORE
Search
BALLISTICS
Download the free Lapua Ballistics App now!
Lapua Ballistics is the ultimate 6DOF ballistics calculator for mobile devices. It's the first mobile ballistics app utilizing the 6DOF calculation model, which makes it the most accurate ballistics app on the market. With Lapua Ballistics, you can calculate trajectories, range, bullet drop, turret adjustments and more to help take that perfect shot. Lapua Ballistics always offers the latest, Doppler proven Lapua cartridge and bullet data. It also includes the option to define custom bullets manually. At current, the Lapua Ballistics App is available in no less than eight languages: English, German, Finnish, Norwegian, Polish, French, Spanish and Afrikaans, for Android and iOS mobiles, free of charge.
Download on the App Store
GET IT ON Google Play
Features in the Lapua Ballistics calculator
Utilizes 6DOF, the most accurate calculation method
Available in English, German, Finnish, Norwegian, Polish, French, Spanish and Afrikaans
Always available with latest Lapua cartridge / bullet information
Quick and easy to change inputs like shooting distance, wind speed and angle
Several result outputs available depending on your needs; numerical, reticle, table and graph views
Share your ballistic calculation results with your friends

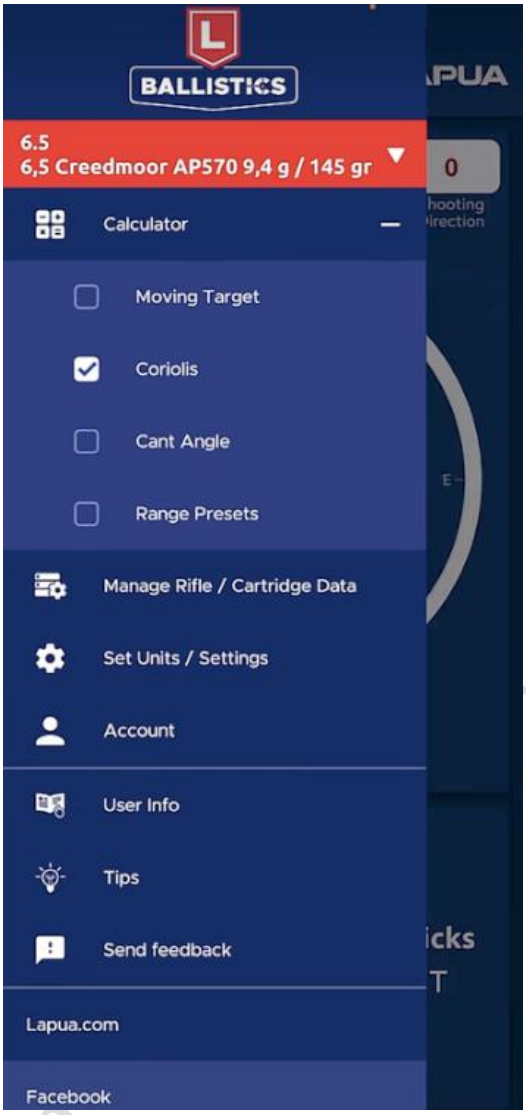
This application has a parameter to take into account, before firing, the adjustment needed to correct for the Coriolis effect based on the shooter's latitude. Indeed, if we consider a specific firing scenario:

translation in



And we go into the app's options to enable the Coriolis effect:

translation into ongoing



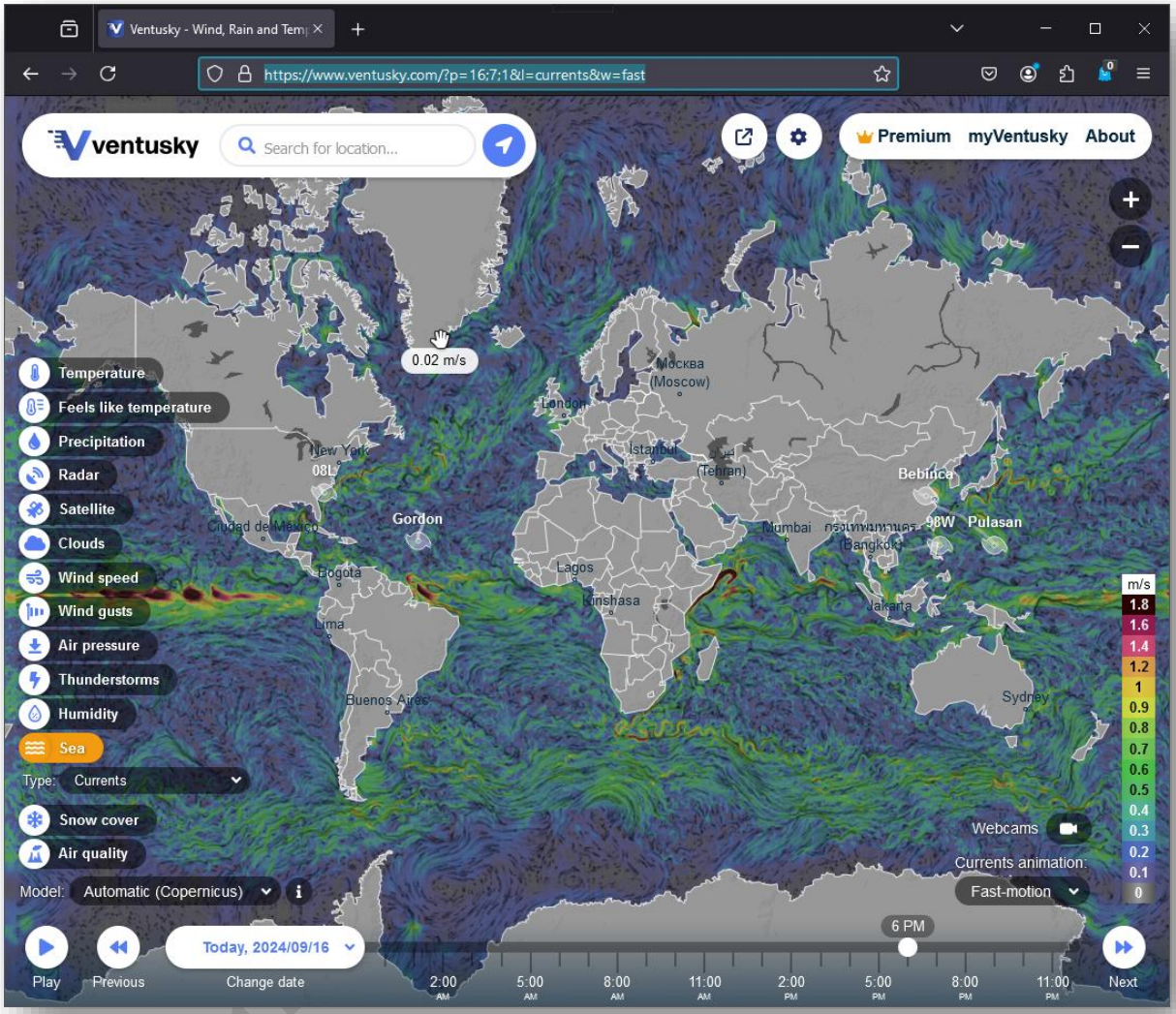
The correction then changes (going from 2 to 3 clicks at 40 degrees latitude):

translation ongoing

translation into ongoing

(#234) Coriolis effect on ocean currents

The Coriolis effect has the same statistical effect on deep or surface ocean currents.



For those who prefer the animated version, it is available here:

https://www.ventusky.com/?p=16;7;1&l=currents&w=fast

translation

(#235) Foucault pendulum

The Foucault pendulum, named after the French physicist Léon Foucault,, is an experimental device designed to demonstrate the Earth's rotation relative to an inertial frame of reference. The result of the experiment in the non-inertial frame of reference linked to a terrestrial observer is explained by the effect of the Coriolis force. The rotation period is given by (Opera Magistris, 2024):

$$T = \frac{T_0}{\sin(\text{latitude})}$$

Foucault's pendulum proves the Earth's rotation and also its sphere, because the pendulum rotates clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere. The pendulum rotates faster closer to the pole. At the equator, the pendulum does not rotate.

As a well-known example of a pendulum, we have the Foucault pendulum in the Northern Hemisphere at the Pantheon in Paris (48°50’46.26"N, 2°20’45.99"E):

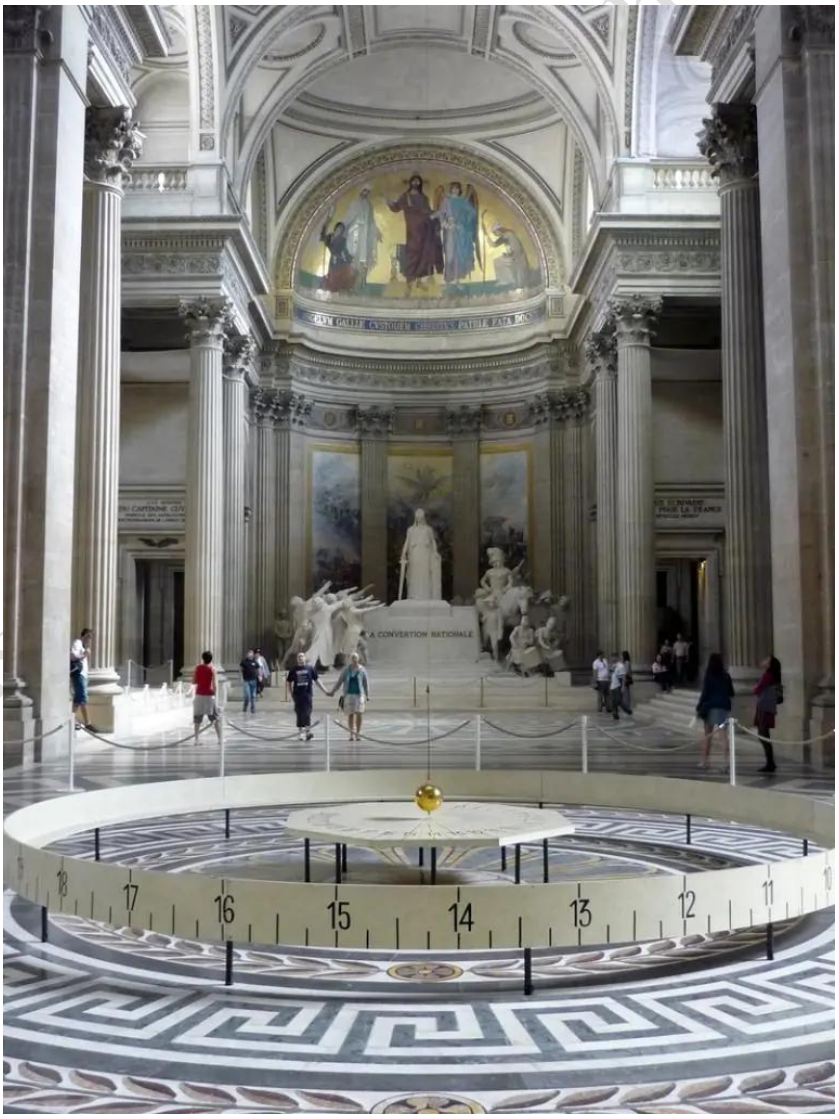
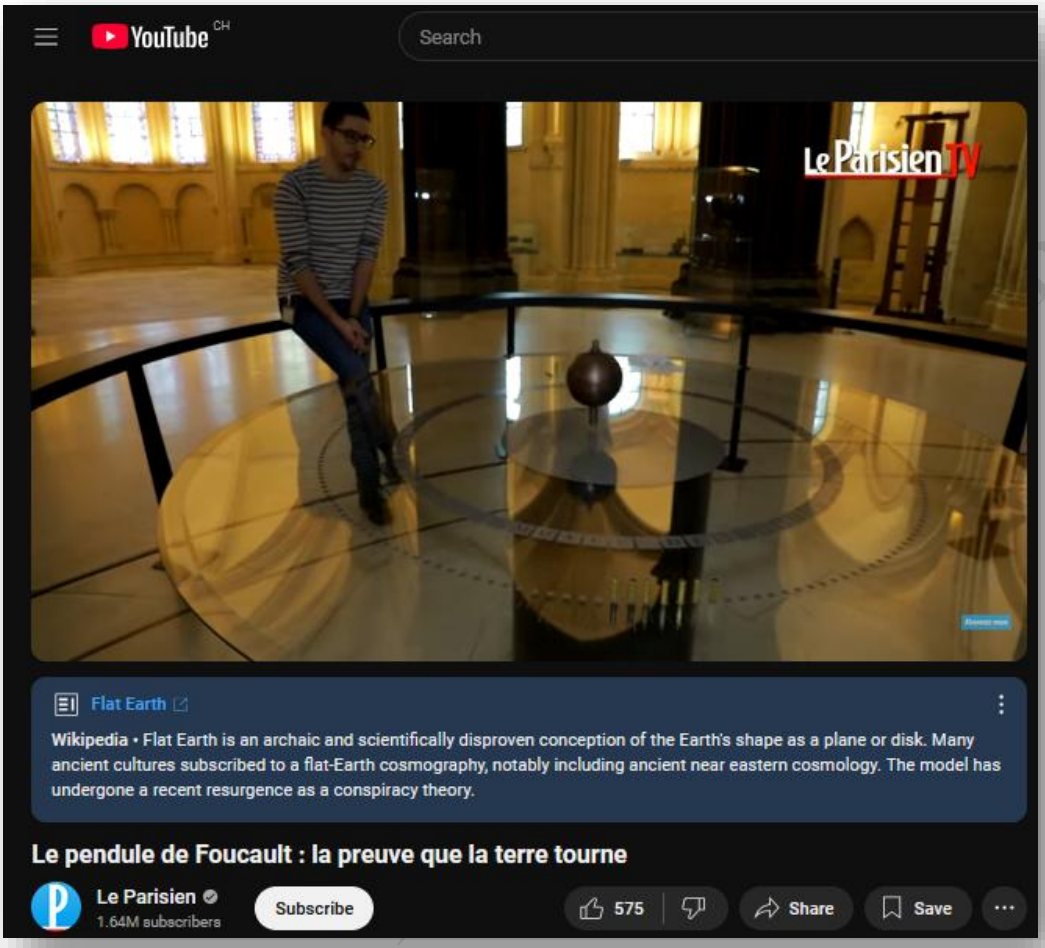


Figure 125 Foucault's pendulum under the vault of the Pantheon in Paris (France)

A nice (but too short) video in french of this pendulum is available here:

https://www.youtube.com/watch?v=i0RBFpazDtk


YouTube CH
Search
Le Parisien TV
Flat Earth
Wikipedia • Flat Earth is an archaic and scientifically disproven conception of the Earth's shape as a plane or disk. Many ancient cultures subscribed to a flat-Earth cosmography, notably including ancient near eastern cosmology. The model has undergone a recent resurgence as a conspiracy theory.
Le pendule de Foucault : la preuve que la terre tourne
Le Parisien
1.64M subscribers
Subscribe
575
Share
Save

And in the Southern Hemisphere at the Museum of Science and Technology, Santiago, Chile (34°27’55.04"S, 58°29’52.91"W) we have the Foucault pendulum lighthouse:

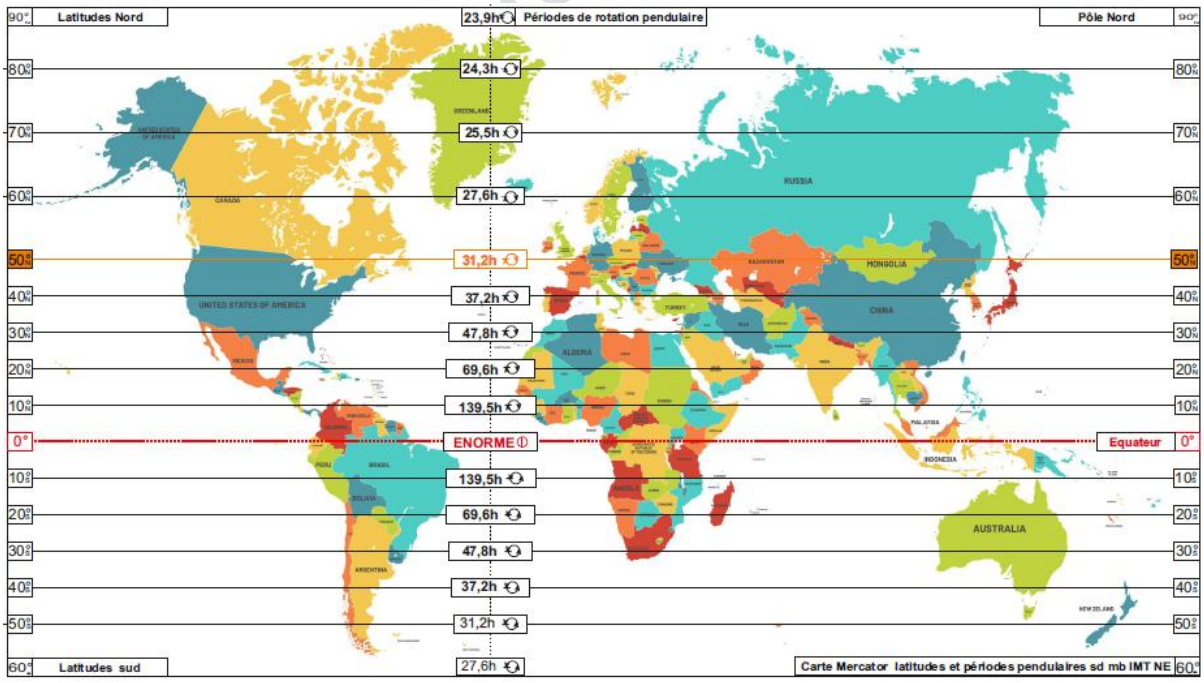
translation

Figure 126 Péndulo de Foucault, Costanera de la Ciencia. Valdivia, Chile (author : Alejandra Márquez)

A nice (but too short) video of this pendulum is available here:

https://www.youtube.com/watch?v=jPlYsTrtMgQ

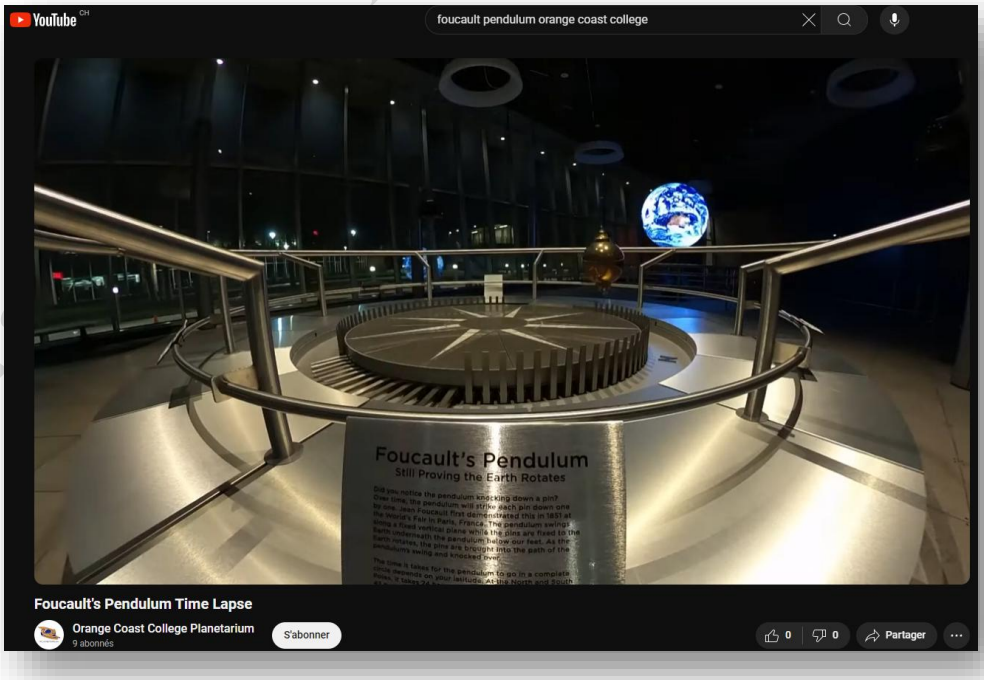
For those interested, here is a diagram showing the periods of the pendulums as a function of latitude:



And for those who live in France, there are many Foucault pendulums in France:

A timelapse of the Foucault pendulum at the Orange Coast College Planetarium (2701 Fairview Rd, Costa Mesa, CA 92626, USA) can be seen here:

https://www.youtube.com/watch?v=8osQrCrHGTU



(#236) Eötvös effect (Eötvös force)

The Eötvös effect, discovered in 1900, is the change in measured Earth's gravity caused by the change in centrifugal acceleration resulting from the eastward or westward speed of ships, aircraft, and submarines measuring Earth's gravity (see (Experimenteller Nachweis der Schwereänderung, die ein auf normal geformter Erdoberfläche in östlicher oder westlicher Richtung bewegter Körper durch diese Bewegung erleidet, 1919) and (Beiträge zum gesetze der proportionalität von trägheit und gravität, 1922)).

As it moves eastward, the object's angular velocity increases (in addition to the Earth's rotation), and therefore the (fictitious) centrifugal force also increases, causing a perceived reduction in gravitational force. If the Earth were flat, however, there would be no Eötvös effect. If the flat Earth does not rotate (as most flat earths models assume, with the Sun moving above it in a circular path), it is obvious that there would be no centripetal acceleration. Even if you adopt a model where the flat Earth rotates around the North Pole, the centripetal acceleration at every point on the surface is parallel to the surface, toward the pole, and not directed downward. Thus, an Eötvös-type effect would actually cause a slight deflection of the angle of gravity, but an almost negligible change in the intensity of gravity.

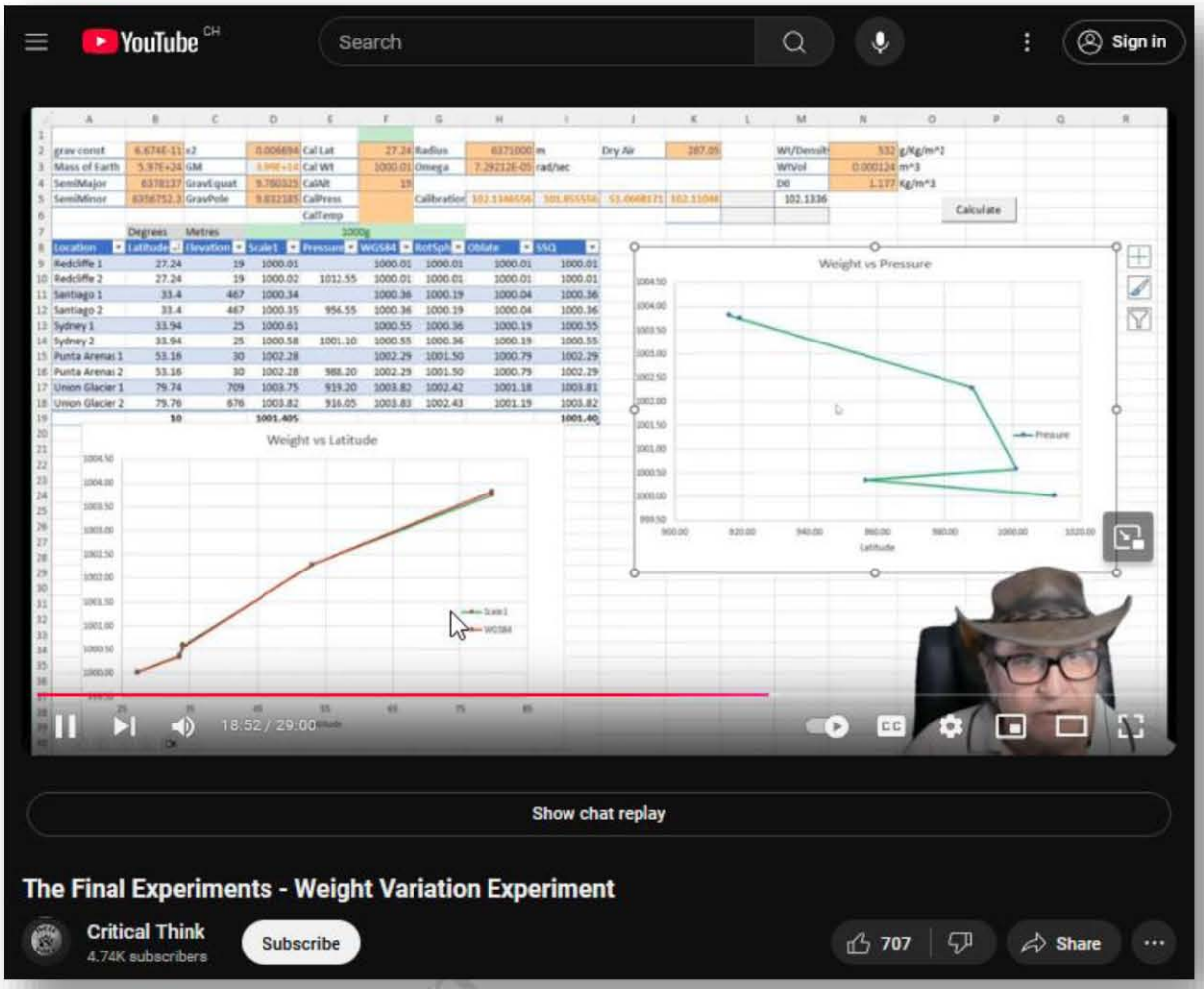
The Eötvös effect thus shows that not only does the Earth rotate, but that it rotates around a central point located beneath the Earth, not somewhere on the surface. If you stand on the equator and face east, the Earth's surface rotates in the direction you are facing and downwards, not to the left or right. Furthermore, the cosine term shows that at equal latitudes north and south, the rotation occurs at the same angle to the surface, which can only be the case if the Earth is symmetrical about the equator: that is, spherical!

This force manifests itself when measuring the acceleration due to gravity on board a moving object. Historically, it was detected during gravimetric measurements on board moving ships.

During "The Final Experiment," one of the experiment's members, at the end of 2024, took some measurements to verify that gravity did indeed vary with latitude during his journey to Antarctica. He did so in a filmed and educational manner, while maintaining satisfactory scientific rigor. The link to the main video is available:

https://www.youtube.com/watch?v=y3lNv2-2JPM

translation into english pages



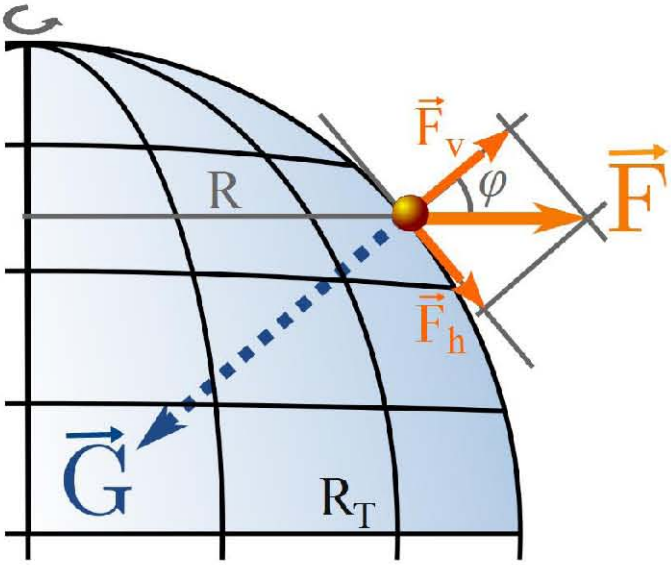


Figure 127 Force diagram (author: Antoni Salvà, source: Wikipedia)

The Eötvös force, G_e is equal to (Opera Magistris, 2024):

$$G_e = 2\Omega u \cos(\phi) + \frac{u^2 + v^2}{R}$$

Where :

- Ω is the Earth's rotation speed (pulsation) ;
- u is the speed in the latitudinal direction (east-west) ;
- ϕ is the latitude where the measurements are taken ;
- v is the speed in the longitudinal direction (north-south) ;
- R is the radius of the Earth.

Here is the intensity of the Eötvös acceleration for a ship sailing at a speed of 40 km/h (11.111 m/s) at a latitude of 45 degrees:

$$G_e = 2\Omega u \cos(\phi) + \frac{u^2 + v^2}{R} = 2.272 \cdot 10^{-5} \cdot 11.111 \cdot \cos(0.7874) + \frac{11.111^2 + 0^2}{6'371 \cdot 10^3}$$
$$\cong 1.16 \cdot 10^{-3}\ [\mathrm{m \cdot s^{-1}}]$$

translation into english ongoing

(#237) Sagnac effect

First, a word of caution! The Sagnac effect is often (wrongly!) confused with the Coriolis effect.

The Sagnac effect is a physical phenomenon discovered by the French physicist Georges Sagnac in 1913. It occurs when a beam of light is split in two and the two beams travel in opposite directions along a circular path on a rotating platform. At the end of their path, the two beams rejoin with a phase shift due to the platform's rotation.

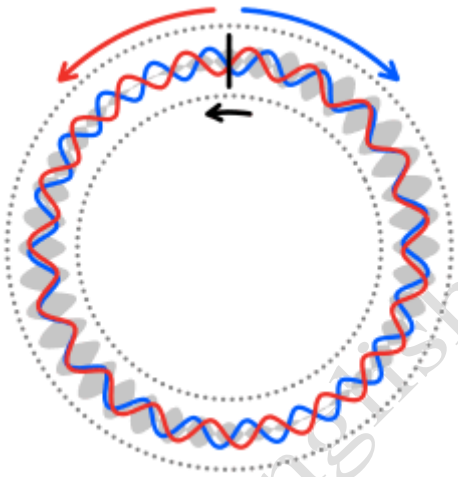


Figure 128 Illustration of the Sagnac effect (source : http://www.cleonis.nl/physics/phys256/sagnac.php)

This phase shift is proportional to the rotation speed of the platform and the surface area of the circular path.

$$\delta t = \frac{4\omega\pi R^2}{c^2}$$

What's interesting is that the Sagnac effect measures linear rotational speed, not angular rotational speed. The Earth rotates once a day—this angular rotational speed is constant across the entire planet and can be modeled in a flat-Earth model simply by assuming the Earth is a rotating disk, like a vinyl record or a Blu-ray disc. But the linear rotational speed of points on the Earth's surface varies!

The Sagnac effect is used in modern technologies such as fiber optic gyroscopes and laser gyroscopes, which are essential for the navigation of airplanes, spacecraft, and even smartphones. It is also used to measure minute variations in the Earth's rotation speed (The centennial of the Sagnac experiment in the optical regime: From a tabletop experiment to the variation of the Earth's rotation, 2014).

The Sagnac effect can be quantified using gyrolasers:

translation into english ongoing

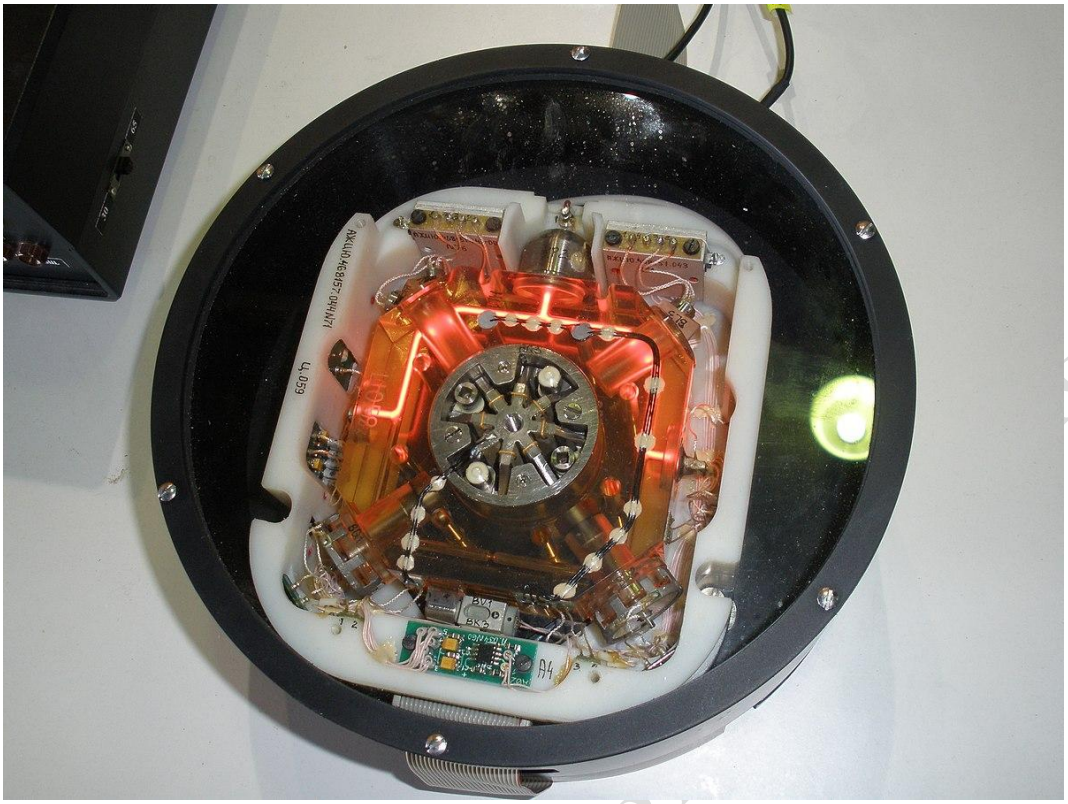
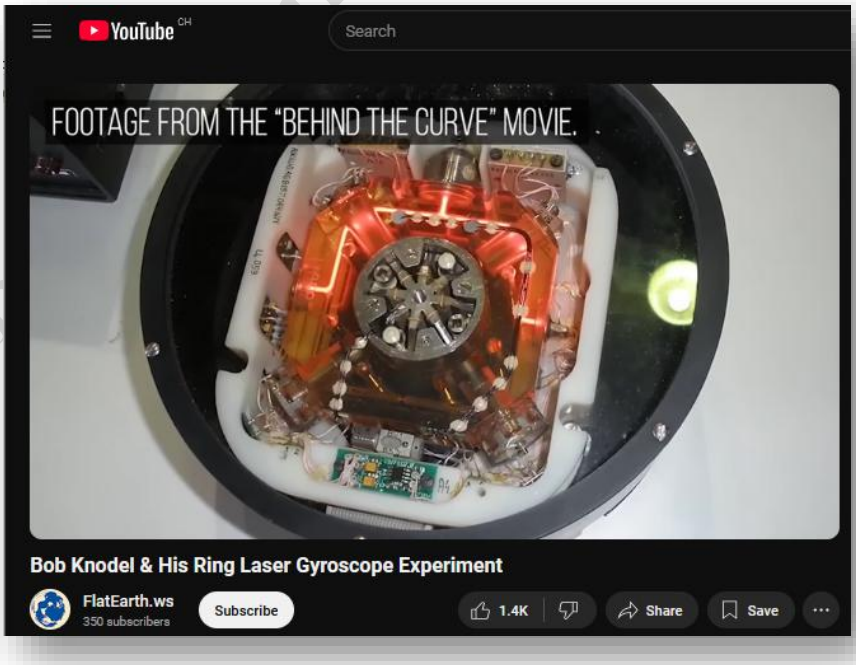


Figure 129 Gyrolaser (source : Wikipedia)

Flat-Earthers in the United States bought a $20,000 gyrolaser only to discover that… the Earth does indeed rotate and is a globe!

https://www.youtube.com/watch?v=SrGgxAK9Z5A



They obviously rejected the result, which did not conform to their beliefs despite the evidence!

(#238) Walker's Law and Garstang's Model

The artificial glow of the sky (the "bright halo") appears prominently in the sky above cities. It makes the night sky appear brighter as seen from within the city, making it difficult, if not impossible, to see fainter stars. A city's glow can be seen from dark places up to hundreds of kilometers away, like a dome of bright sky above the city on the horizon. However, while a city's glow can be seen from such a distance, the much brighter lights of the city itself cannot be seen directly—because they are below the horizon.

The fact that you can observe the fainter glow of the sky above a city without being able to directly see the city lights is due to the curvature of the Earth. This isn't the only effect of the Earth's curvature on the appearance of the sky glow; it also affects the glow's brightness. In the absence of scattering or absorption, the intensity of the light decreases with distance from the source according to an inverse-square law. Physically, this is because, as we know, the surface area of spherical shells of increasing radius from a light source increases as the square of the radius.

In 1977, Merle F. Walker of the Lick Observatory in California published a study on the brightness of the night sky caused by skyglow at varying distances from several cities in Southern California (see (The effects of urban lighting on the brightness of the night sky, 1977)). He found an empirical relationship whereby the intensity of skyglow varies as the inverse of the distance to the power of 2.5. This relationship, known as "Walker's Law," has been confirmed by subsequent studies, with one notable addition. It applies only to distances of up to 50–100 kilometers from the city. As you move away from a city, the intensity of skyglow begins to decrease more rapidly than Walker's Law suggests—a little faster at first, but increasingly more rapidly thereafter. This is due to the fact that, in addition to the absorption effect, the path of the scattered light becomes longer and more complex because of the curvature of the Earth.

A subsequent study by the eminent astronomical light pollution researcher Roy Henry Garstang, published in 1989, examined data from several cities in Colorado, California, and Ontario to produce a more detailed model of night sky brightness intensity (see (Night sky brightness at observatories and sites, 1989)). The model was then tested and verified for several astronomical sites in the continental United States, Hawaii, Canada, Australia, France, and Chile. Importantly for our perspective, **Garstang's model requires that the Earth's surface be curved**. Interestingly, Garstang **also calculated a model for night sky brightness intensity assuming the Earth is flat**! He did this because it greatly simplifies the geometry and the resulting algebra, to see if it produced sufficiently accurate results. However, quoting directly from the paper:

« *The magnitudes of curvature corrections depend on the circumstances in each case. We made a few calculations using both the flat-Earth and the curved-Earth models. In general, flat-Earth models are satisfactory for small city distances and observations at small zenith distances. As a rough rule of thumb we can say that for calculations of night-sky brightnesses not too far from the zenith the curvature of the Earth is unimportant for distances of the observer of up to 50 km from a city, at which distance the effect of curvature is typically 2%.* ***For larger distances the curved-Earth model should always be used, and the curved-Earth model should be used at smaller distances when calculating for large zenith distances.*** *In general we would use the curved-Earth model for all cases except for city-center calculations (such as we discussed in*

translation into english ongoing

Paper I). […] As would be expected, we find that the inclusion of the curvature of the Earth causes the brightness of large, distant cities to fall off more rapidly with distance than for a flat-Earth model. »

For the skeptics, here is a screenshot of the original paper with this passage:

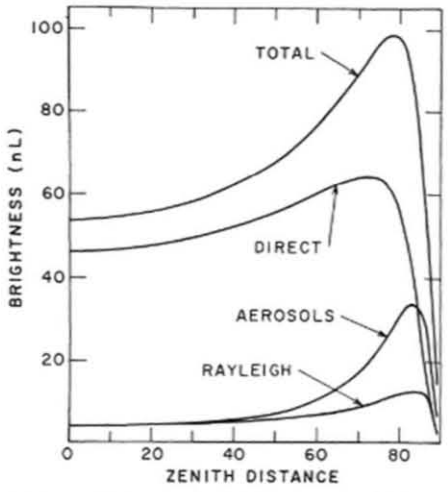


FIG. 4–Contributions to the night-sky brightness by directly transmitted light, by Rayleigh scattering, and by aerosol scattering, calculated for Mount Graham.

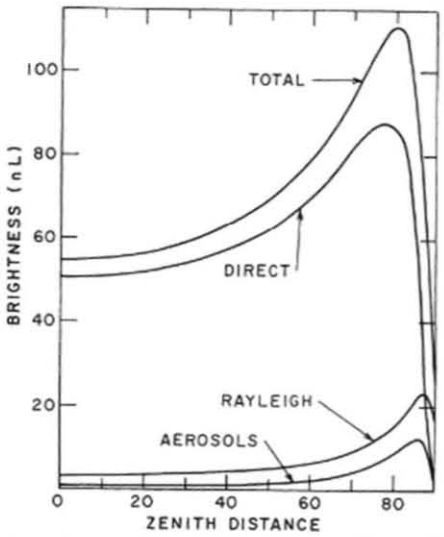


FIG. 5–Contributions to the night-sky background brightness by directly transmitted light, by Rayleigh scattering, and by aerosol scattering, calculated for Boulder.

level. The four sets of results have been expressed as ΔV, the brightness increase over that at the zenith, in magnitudes per square second. These results are shown in Figure 6. We show for comparison a set of measures of ΔV obtained by Walker (1987) at Junipero Serra Peak. We regard the agreement between his measures and our calculations as satisfactory.

4. Brightness-Distance Relation

We have investigated whether the inclusion of the curvature of the Earth affects any of the results in Paper I. Most of those results are affected only to a negligible extent. Those results which refer to large distances are affected to a greater extent. The magnitudes of curvature corrections depend on the circumstances in each case. We made a few calculations using both the flat-Earth and the curved-Earth models. In general, flat-Earth models are satisfactory for small city distances and observations at small zenith distances. As a rough rule of thumb we can say that for calculations of night-sky brightnesses not too far from the zenith the curvature of the Earth is unimportant for distances of the observer of up to 50 km from a city, at which distance the effect of curvature is typically 2%. For larger distances the curved-Earth model should always be used, and the curved-Earth model should be used at smaller distances when calculating for large zenith distances. In general we would use the curved-Earth model for all cases except for city-center calculations (such as we discussed in Paper I). We have repeated our brightness-distance relation calculations for large distances. We have fitted formulae of the form $b = \mathrm{CPD}^{\alpha}$ for the brightness b at distance D from a city of population P, with the index α determined as the slope of the $\log b - \log D$ graph for a value of b of 0.01 times the natural background. The results are listed in Table 1. Linear interpolation of α and $\log C$ as functions of $\log P$ is adequate: A more elaborate treatment is not justified. Our results should be compared with our earlier results from the flat-Earth model which were given in Paper I and are repeated in Table 1 of this paper. As would be expected, we find that the inclusion of the curvature of the Earth causes the brightness of large, distant cities to fall off more rapidly with distance than for a flat-Earth model.

5. Other Relationships

We have recalculated the population-distance relation, which gives the distance at which a city of a given population gives a brightness increase of 0.2 magnitude over the natural background at a zenith distance of 45° in the direction toward the city. Our results are shown in Figure 7, the curve U referring to our standard model ("unenhanced") and the

(#239) The Araucaria Columnaris tree

The columnar tree (Araucaria columnaris) grows in New Caledonia and on other Pacific islands. Scientists have observed that these trees lean slightly toward the equator. If the Earth were flat, there would be no reason for these trees to lean in this way. This lean is consistent with the fact that the Earth is a sphere, as the trees grow perpendicular to the planet's curved surface.

In summary, the tilt of Araucaria columnaris adds to the body of evidence that shows the Earth is a sphere, such as satellite photos, astronomical observations and travels around the world.

The scientific study on the subject (Worldwide hemisphere-dependent lean in Cook pines, 2017) scientifically demonstrates (with a *p*-value of 0.001) this phenomenon, which clearly demonstrates the globe:

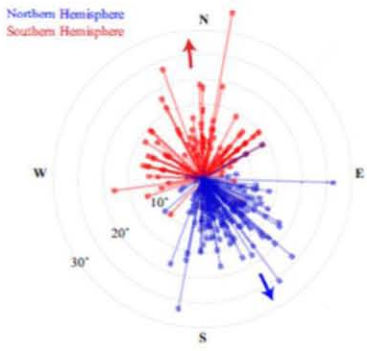


FIG. 2. Hemisphere-dependent magnitude and azimuth of lean for each measured tree ($n = 256$). The circular position of each point gives the compass azimuth. Cardinal directions are marked. The magnitude of lean is given by lines radiating from the center and measured in degrees from vertical, as indicated by concentric circles. Red points represent samples from the southern hemisphere, and blue points those from northern hemisphere. Arrows indicate mean azimuth of lean for trees in each hemisphere.

only the north-south axis component (scalar) of lean azimuth, or "axial lean" (Appendix S1). We found that a simple linear regression explains 54% of the variance, suggesting that trees lean more the further they are from the equator ($R^2 = 0.543$, $F_{1,254} = 304.4$, $P << 0.001$).

The cause of directional lean in this species is unclear. Vertical growth in shoots is generally maintained by a negative relationship with gravity (negative gravitropism; Hashiguchi et al. 2013) and a positive relationship with their light source (positive phototropism; Darwin and Darwin 1880, Loehle 1986, Christie and Murphy 2013). Non-vertical shoot growth can be caused by mechanical perturbation from wind or snow or by a phototropic response to a light source that is not directly above the shoot (Tomlinson 1983, Telewski 2006). Mechanistic studies in *Arabidopsis thaliana* have identified several gene families whose regulation effects phototropic and gravitropic growth in plants. However, the mechanisms controlling the expression of these genes and the interactions between them are not well understood, especially for woody species (Wyatt and Kiss 2013).

The leading hypothesis for the molecular mechanism of gravitropism is that sedimentation of amyloplasts on actin microfilaments activates a signal transduction pathway resulting in asymmetric transport of auxin in the stem, causing it to straighten itself parallel with the gravity vector (Hashiguchi et al. 2013). This hypothesis, like phototropism, is supported by the identification of genes whose proper expression is necessary for observing a gravitropic phenotype.

Phototropism acts principally during primary growth in shoot tips to maintain an upright form in trees (Speck and Burgert 2011). Once secondary growth begins in stems, trees correct asymmetrical growth by forming reaction wood (Sinnott 1952, Du and Yamamoto 2007). Reaction wood results from asymmetric growth in the vascular cambium and can cause a leaning stem to correct itself to vertical. Although the mechanisms are different in gymnosperms (compression wood) and angiosperms (tension wood), trees can reestablish vertical growth after external forces cause leaning (Plomion et al. 2001).

The mechanisms underlying directional lean of *Araucaria columnaris* may be related to an adaptive tropic response to the incidence angles of annual sunlight, gravity, magnetism, or any combination of these (Loehle 1986, Christie and Murphy 2013). It is interesting that the pronounced lean in *A. columnaris* is rare in other species, including other *Araucaria* native to New Caledonia. It is possible that the biophysical constraints of

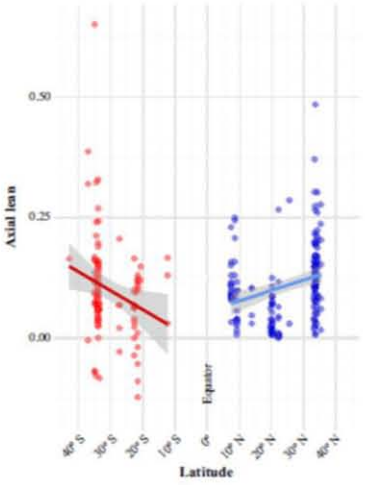


FIG. 3. Axial lean vs. latitude ($n = 256$). Axial lean gives a measure north-south component lean. It is calculated as the magnitude of lean multiplied by the cosine of the lean azimuth. Latitude is a strong predictor of axial lean ($R^2 = 0.543$, $F_{1,254} = 304.4$, $P << 0.001$). For clarity, we show the absolute value of axial lean separated for each hemisphere, so that increasing values indicate greater axial lean away from the equator.

Electromagnetism

(#240) Magnetic dipole and convergence of field lines

The magnetic field also poses a very big problem for flat-Earthers! On a spherical model, it looks like this (Opera Magistris, 2024) :

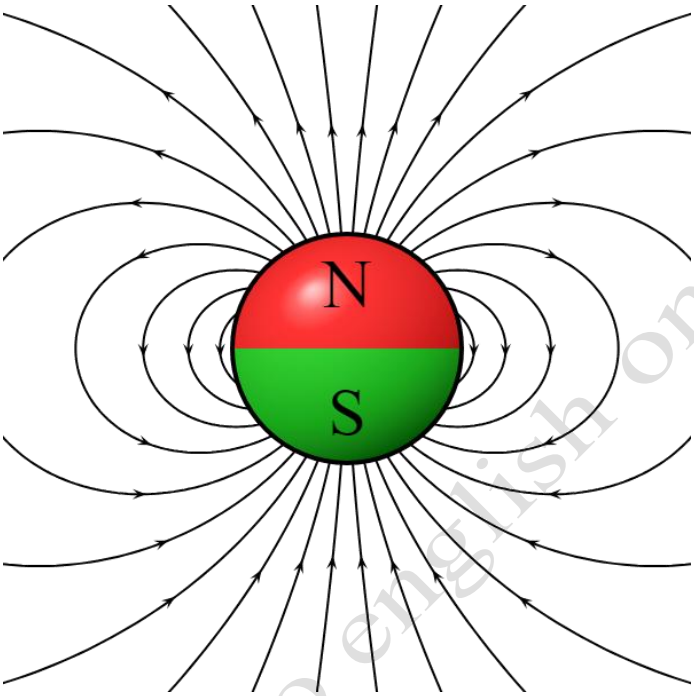
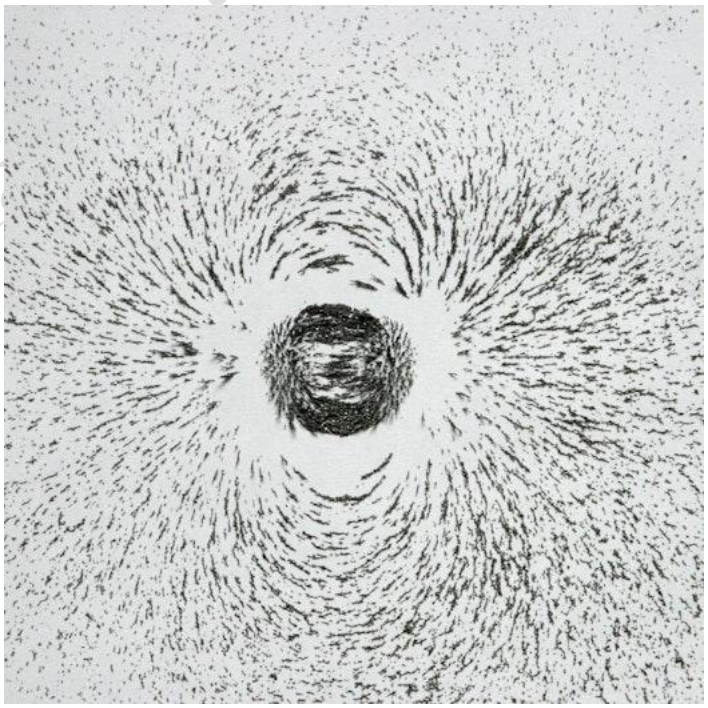


Figure 130 Drawing of a homogeneously magnetized spherical magnet (source: Wikimedia, author: Geek.3)

Or, in reality, on a smaller scale:



translation into english ongoing

Or :

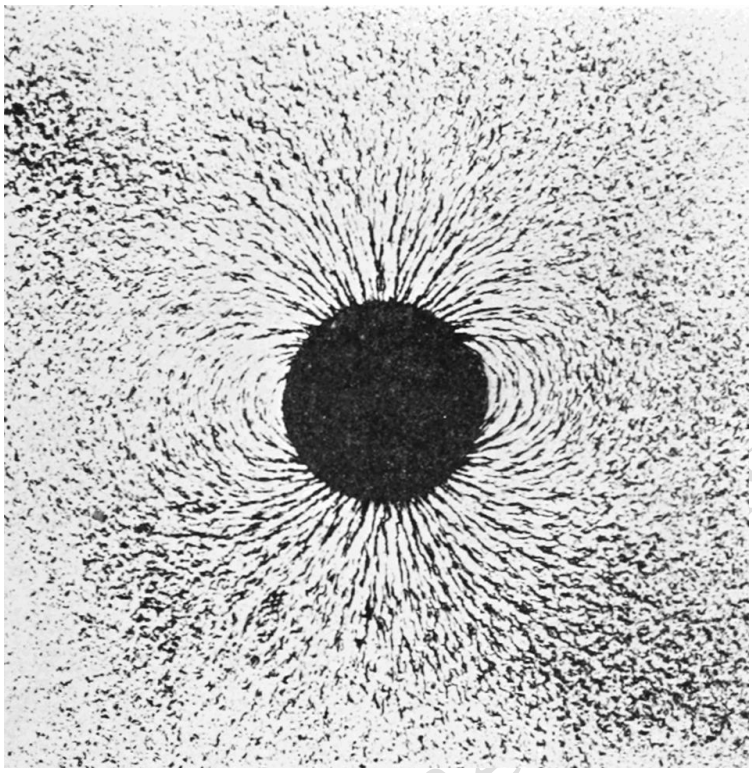


Figure 131 The alignment of the iron filings confirms the shape of the calculated field lines (source: Popular Science Monthly Volume 83)

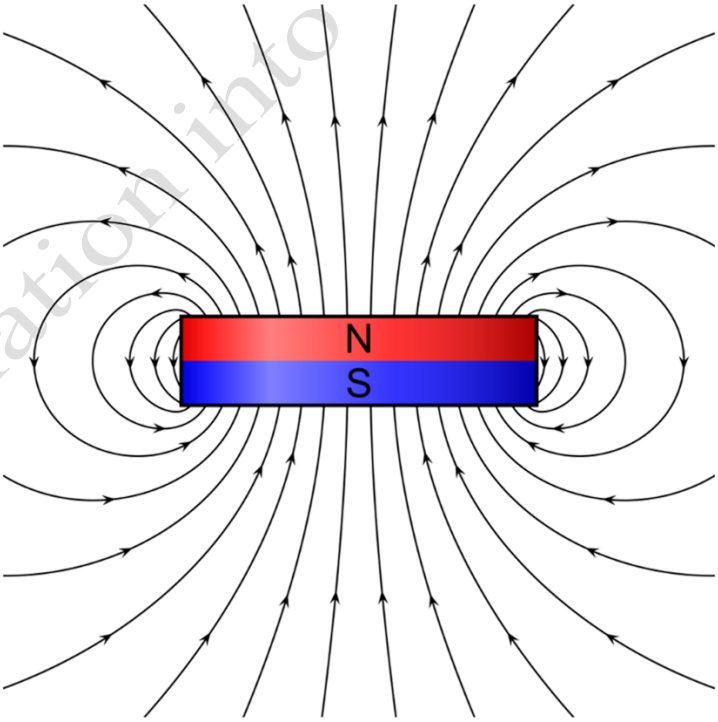


Figure 132 Magnetic field lines of a disk (source: VFPt flat cylinder magnet potential, by Geek3 and modified by Alyssa J. Pasquale, PhD, CC-BY-SA 4.0 license)

translation into english ongoing

In reality, we can clearly see that the cylindrical magnet below does not have its South pole on an annular edge (contrary to the model of flat Earth proponents):

So, in the flat Earth hypothesis, a compass needle should point vertically to the ground (i.e., towards the sky). But since this isn't the case, it's obvious that the flat Earth proponents' hypothesis is, once again, wrong…

For comparison purposes… :

translation in

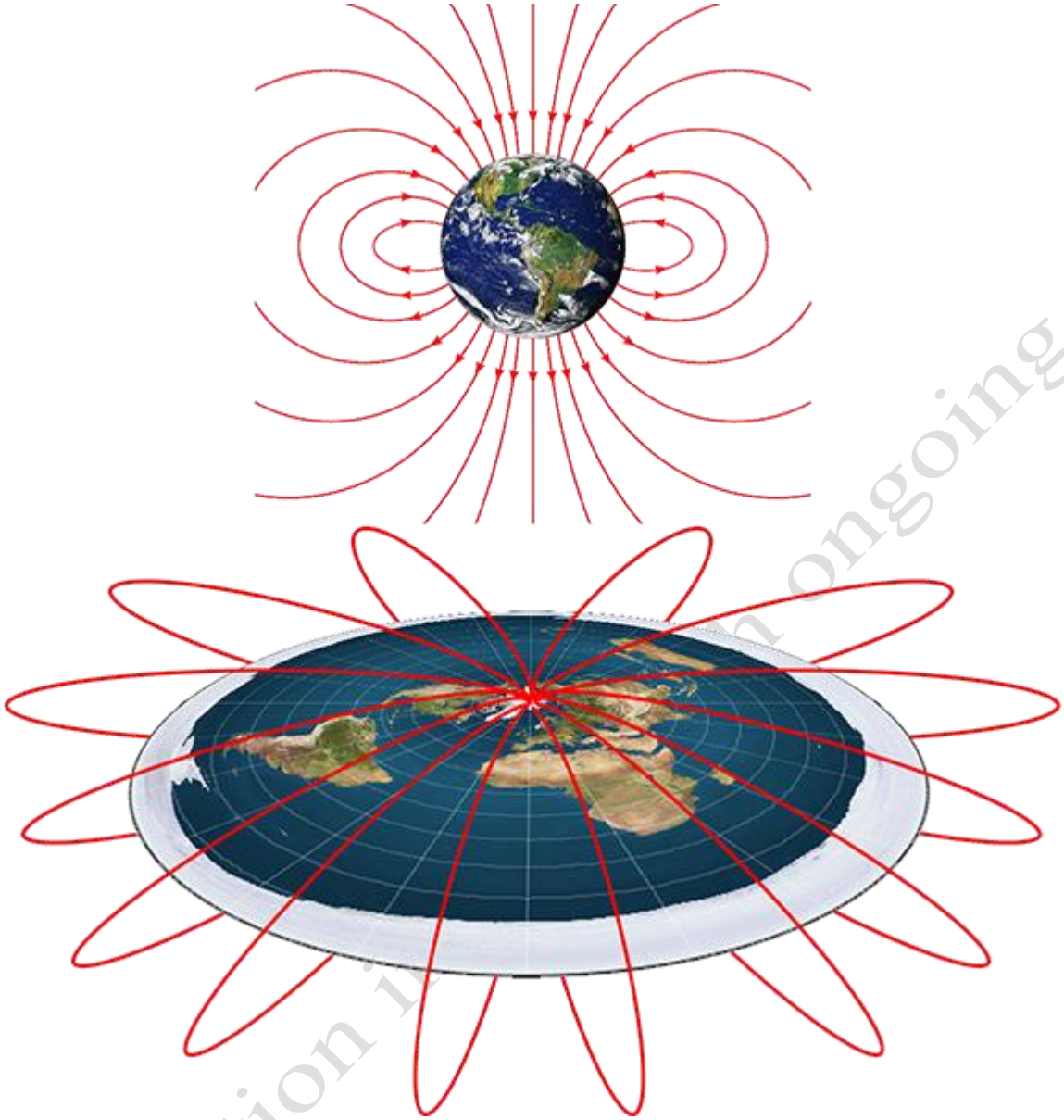


Figure 133 Magnetic field lines of Spherical Earth vs. Flat Earth (source : https://www.mezzacotta.net/100proofs/)

The convergence of field lines corresponds well to the fact that concentric auroras are observed at both the North **and** South Poles:

translation in progress ongoing

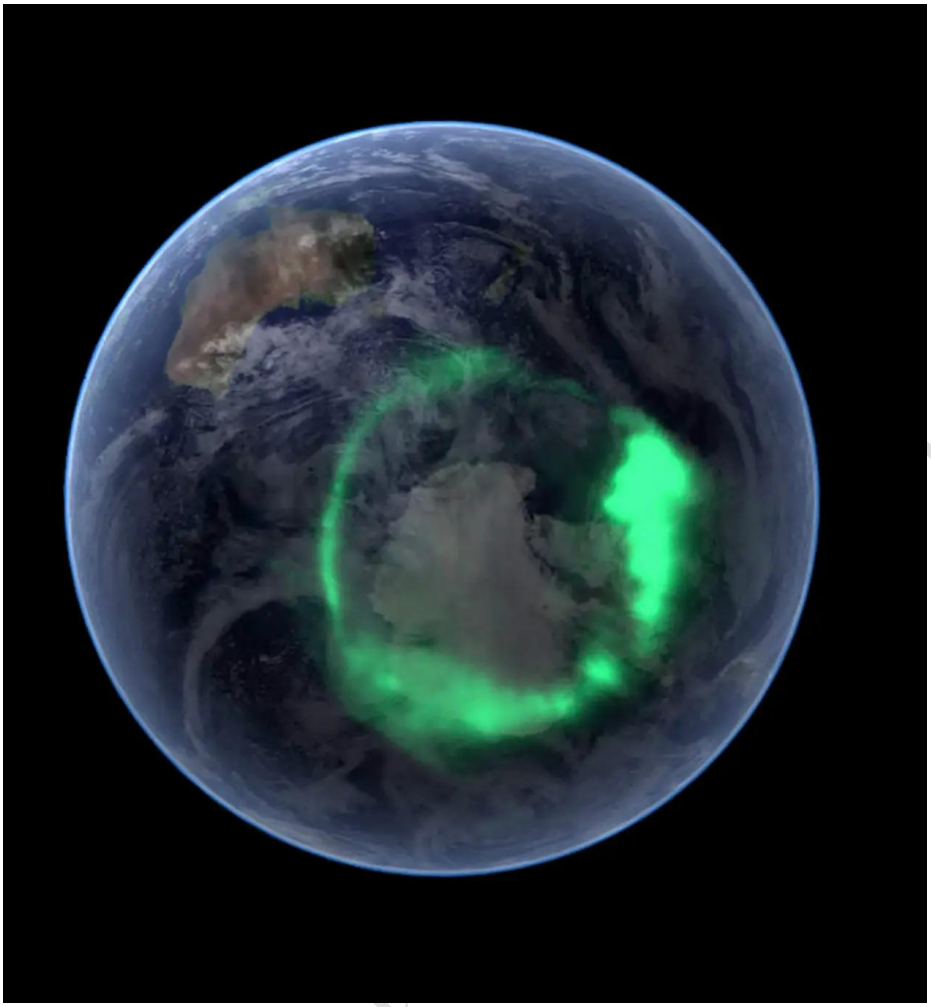


Figure 134 Southern aurora captured by NASA's IMAGE spacecraft in 2005 (credit: NASA/GSFC)

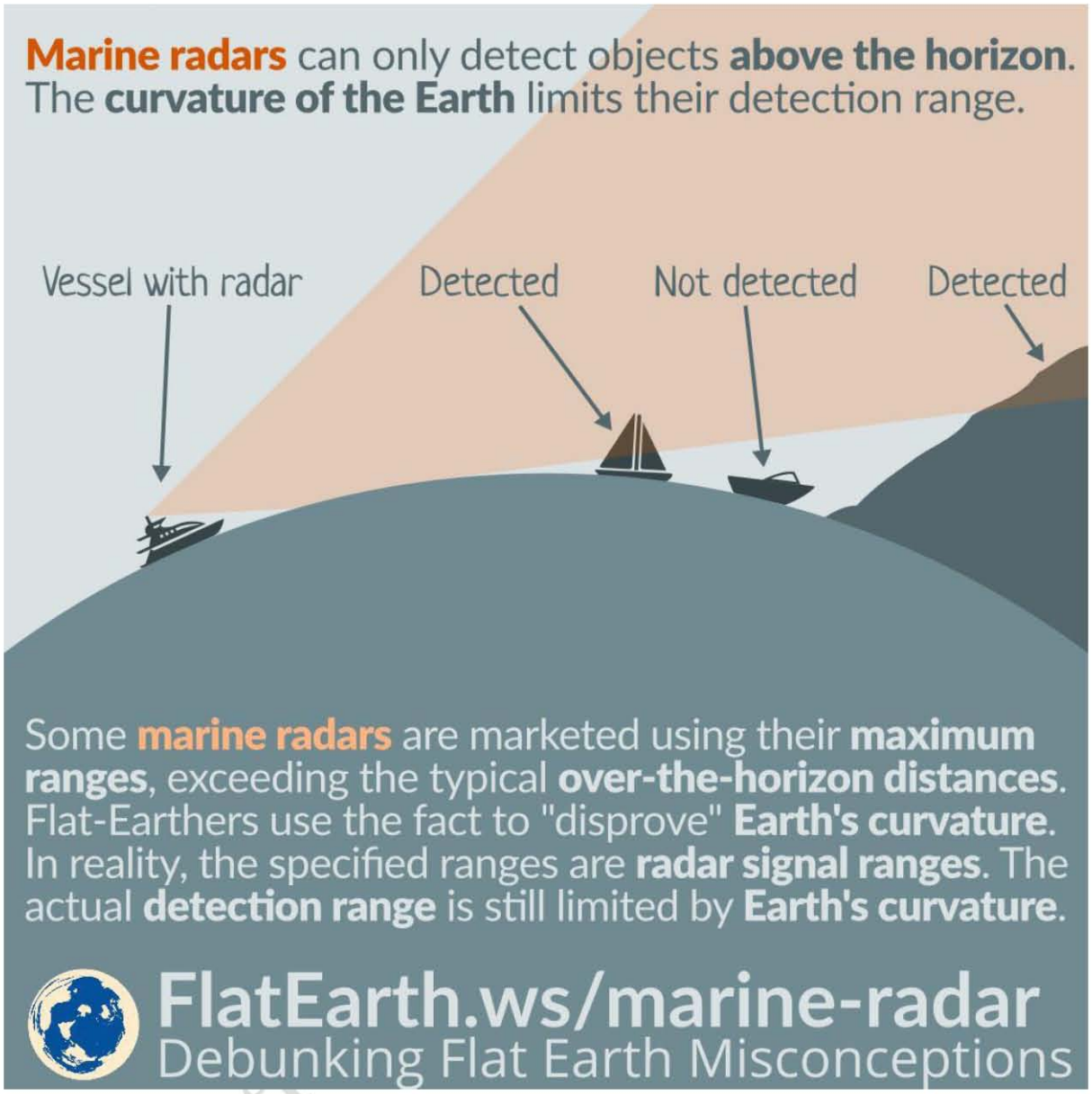
translation in

(#241) Radar wave propagation

Just as humans see using electromagnetic waves, standard radars cannot see objects below the horizon under normal temperature and pressure conditions. To see below the horizon at the under normal temperature and pressure conditions, engineers must use OTHR (Over-the-Horizon Radars) which bounce the signal off the ionosphere (notice the usage of the word "sphere"...) and the signal propagation time is compatible with an oblate spheroid, not a flat Earth (Opera Magistris, 2024)!

Figure 135 US Navy Over-the-Horizon Transferable Radar Station (December 10, 2001, author: US Navy)

An over-the-horizon radar (OTH) is a radar system that allows the detection of targets at very long distances, on the order of several thousand kilometers. For more details, see the scientific publications (Estimating target heights based on the Earth curvature model and micromultipath effect in skywave OTH radar, 2014), (Earth curvature and atmospheric refraction effects on radar signal propagation, 2013), or (The diffraction of radio waves by the curvature of the Earth, 1953).

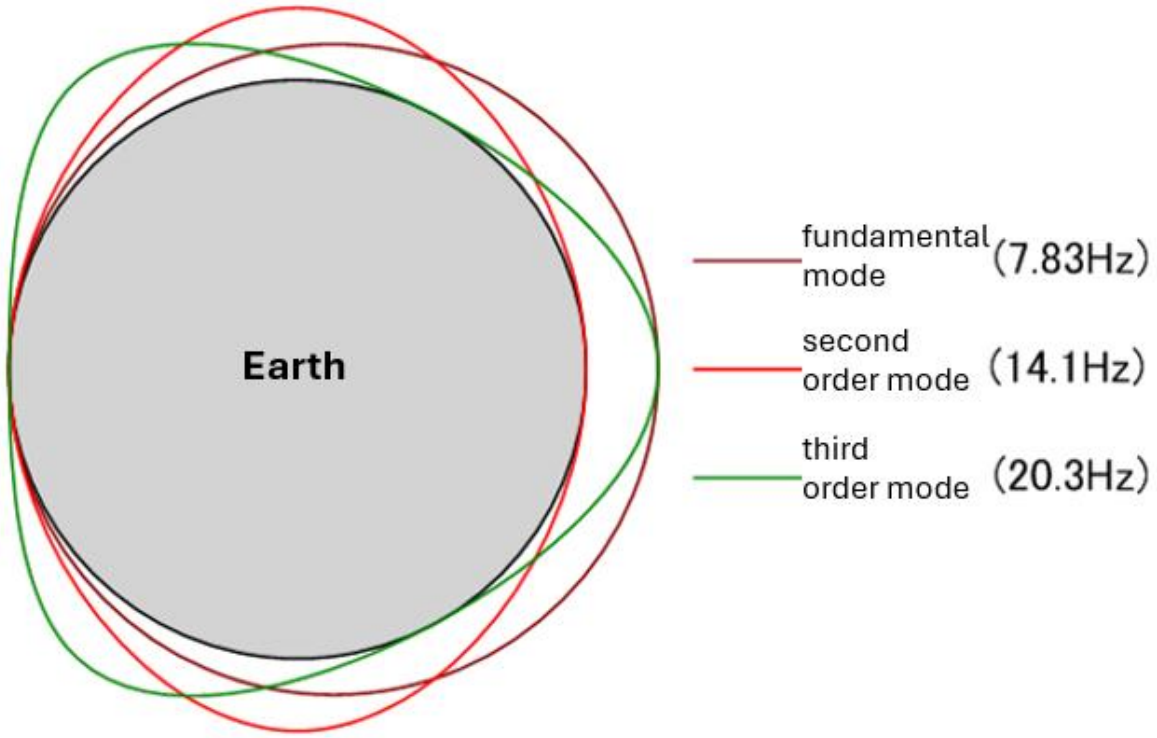

Marine radars can only detect objects above the horizon.
The curvature of the Earth limits their detection range.
Vessel with radar
Detected
Not detected
Detected
Some marine radars are marketed using their maximum ranges, exceeding the typical over-the-horizon distances. Flat-Earthers use the fact to "disprove" Earth's curvature. In reality, the specified ranges are radar signal ranges. The actual detection range is still limited by Earth's curvature.
FlatEarth.ws/marine-radar
Debunking Flat Earth Misconceptions

translati

(#242) Schumann Resonances

The radio waves generated by lightning during a thunderstorm are (among other things) electromagnetic waves with a frequency of 7.8 [Hz] that travel around the world in the waveguide formed by the Earth and the ionosphere, returning one wavelength later to interfere constructively and reinforce each other, producing a measurable peak in the fluctuations of the Earth's magnetic field. The Irish physicist George Francis FitzGerald first anticipated the existence of this effect, called "Schumann resonances," in 1893, but his work was not widely disseminated. Around 1950, the German physicist Winfried Otto Schumann performed the theoretical calculations that predicted the resonances might be observable and made efforts to observe them. But it was only in 1960 that Balser and Wagner made the first successful observations and measurements of Schumann resonances (see (Observations of Earth--ionosphere cavity resonances, 1960)).

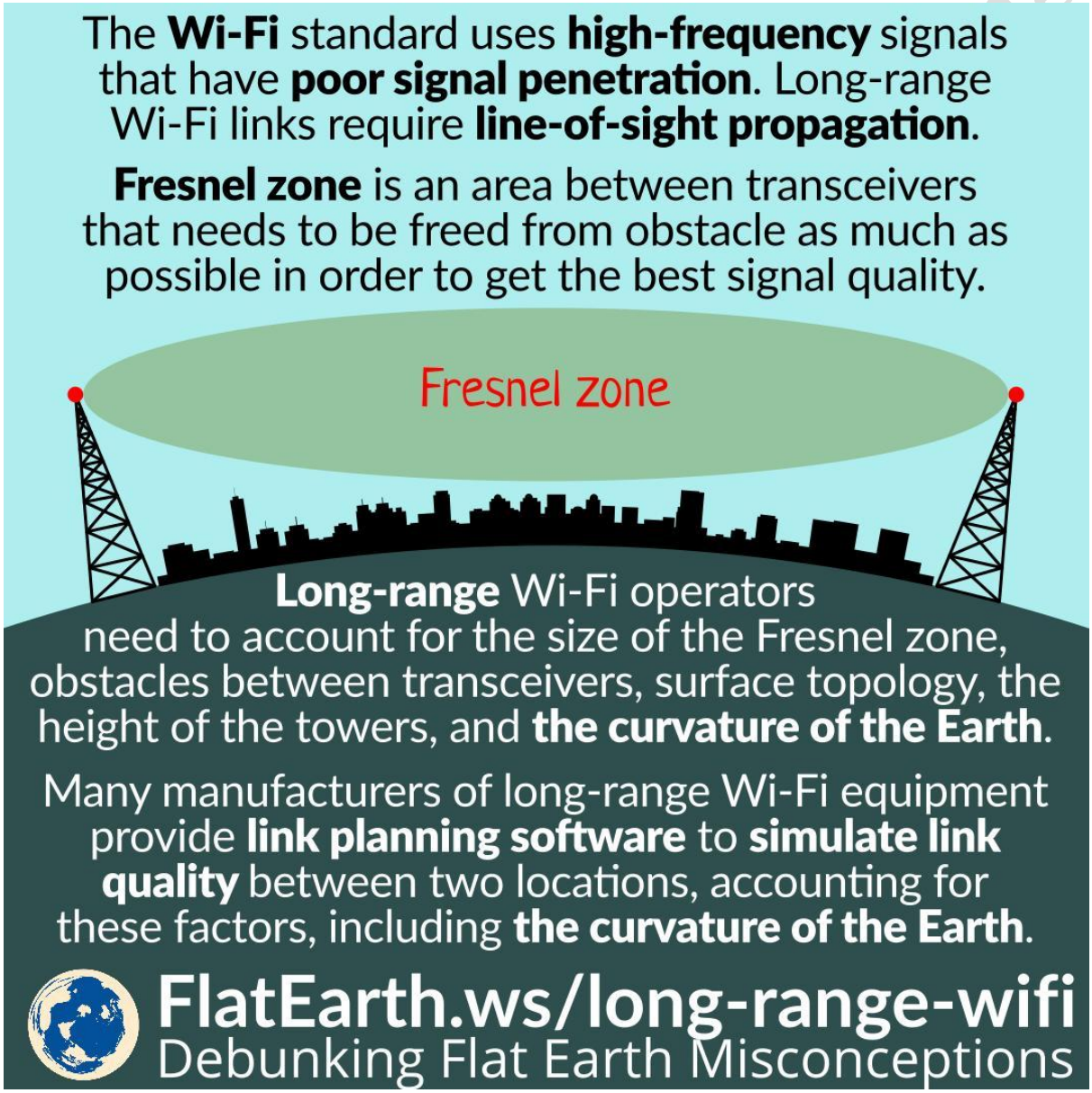
If the Earth were flat, any ionosphere above it would also be flat and would still form a waveguide for low-frequency radio waves. However, it would not be a closed waveguide. The radio waves would propagate past the edges and be lost to space, meaning there would be no observable magnetic field resonance. And even if there were some kind of opaque radio barrier at the edge of the flat Earth, the size and geometry of the resulting cavity would be different, leading to a different set of resonant frequencies.



(#243) Fresnel Zone

The Fresnel ellipsoid is a volume in space used to assess the attenuation caused by an obstacle (building, hill, etc.) to the propagation of a mechanical or electromagnetic wave. It is generally used for VHF, UHF, or microwave links, which would otherwise be in free space without the presence of the obstacle(s). The Fresnel ellipsoid method then allows for the evaluation of the additional attenuation caused by the obstacle.

The Wi-Fi standard uses high-frequency signals that have low signal penetration. Long-range Wi-Fi links require line-of-sight propagation.

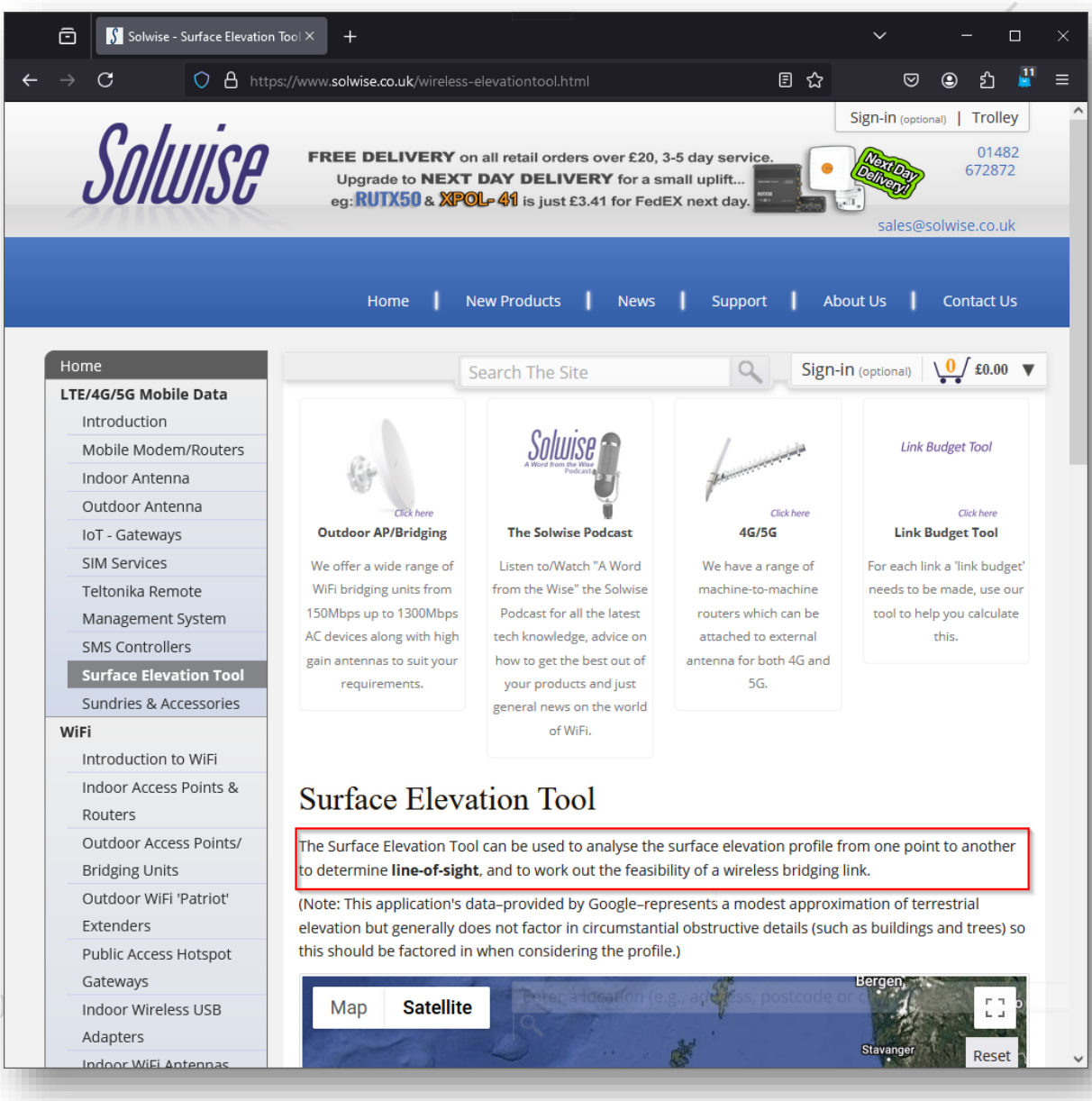

The **Wi-Fi** standard uses **high-frequency** signals that have **poor signal penetration**. Long-range Wi-Fi links require **line-of-sight propagation**.
Fresnel zone is an area between transceivers that needs to be freed from obstacle as much as possible in order to get the best signal quality.
Fresnel zone
Long-range Wi-Fi operators need to account for the size of the Fresnel zone, obstacles between transceivers, surface topology, the height of the towers, and **the curvature of the Earth**.
Many manufacturers of long-range Wi-Fi equipment provide **link planning software** to **simulate link quality** between two locations, accounting for these factors, including **the curvature of the Earth**.
FlatEarth.ws/long-range-wifi
Debunking Flat Earth Misconceptions

Long-range Wi-Fi operators must take into account the size of the Fresnel zone, obstacles between transceivers, surface topology, tower height, and the curvature of the Earth.

Many manufacturers of long-range Wi-Fi equipment provide link planning software to simulate link quality between two locations, taking into account these factors, including the curvature of the Earth.

For example, the company Solwise offers a long-range Wi-Fi sizing tool on its website that takes curvature into account:

https://www.solwise.co.uk/wireless-elevationtool.html


Solwise - Surface Elevation Tool
https://www.solwise.co.uk/wireless-elevationtool.html
Sign-in (optional) | Trolley
Solwise
FREE DELIVERY on all retail orders over £20, 3-5 day service.
Upgrade to NEXT DAY DELIVERY for a small uplift...
eg: RUTX50 & XPOL-41 is just £3.41 for FedEX next day.
Next Day Delivery!
01482 672872
sales@solwise.co.uk
Home | New Products | News | Support | About Us | Contact Us
Home
LTE/4G/5G Mobile Data
Introduction
Mobile Modem/Routers
Indoor Antenna
Outdoor Antenna
IoT - Gateways
SIM Services
Teltonika Remote Management System
SMS Controllers
Surface Elevation Tool
Sundries & Accessories
WiFi
Introduction to WiFi
Indoor Access Points & Routers
Outdoor Access Points/ Bridging Units
Outdoor WiFi 'Patriot' Extenders
Public Access Hotspot Gateways
Indoor Wireless USB Adapters
Search The Site
Sign-in (optional)
£0.00
Outdoor AP/Bridging
We offer a wide range of WiFi bridging units from 150Mbps up to 1300Mbps AC devices along with high gain antennas to suit your requirements.
The Solwise Podcast
Listen to/Watch "A Word from the Wise" the Solwise Podcast for all the latest tech knowledge, advice on how to get the best out of your products and just general news on the world of WiFi.
4G/5G
We have a range of machine-to-machine routers which can be attached to external antenna for both 4G and 5G.
Link Budget Tool
For each link a 'link budget' needs to be made, use our tool to help you calculate this.
Surface Elevation Tool
The Surface Elevation Tool can be used to analyse the surface elevation profile from one point to another to determine line-of-sight, and to work out the feasibility of a wireless bridging link.
(Note: This application's data–provided by Google–represents a modest approximation of terrestrial elevation but generally does not factor in circumstantial obstructive details (such as buildings and trees) so this should be factored in when considering the profile.)
Map
Satellite
Bergen
Stavanger
Reset

There is a scientific book dealing with the subject in relation to Wi-Fi and which deals with taking into account the curvature of the Earth: (Introduction to Wireless Communications and Networks: A Practical Perspectiv, 2022).

Atmosphere

There are several unsolvable problems and absurdities of vocabulary relating to the atmosphere and the flat Earth.

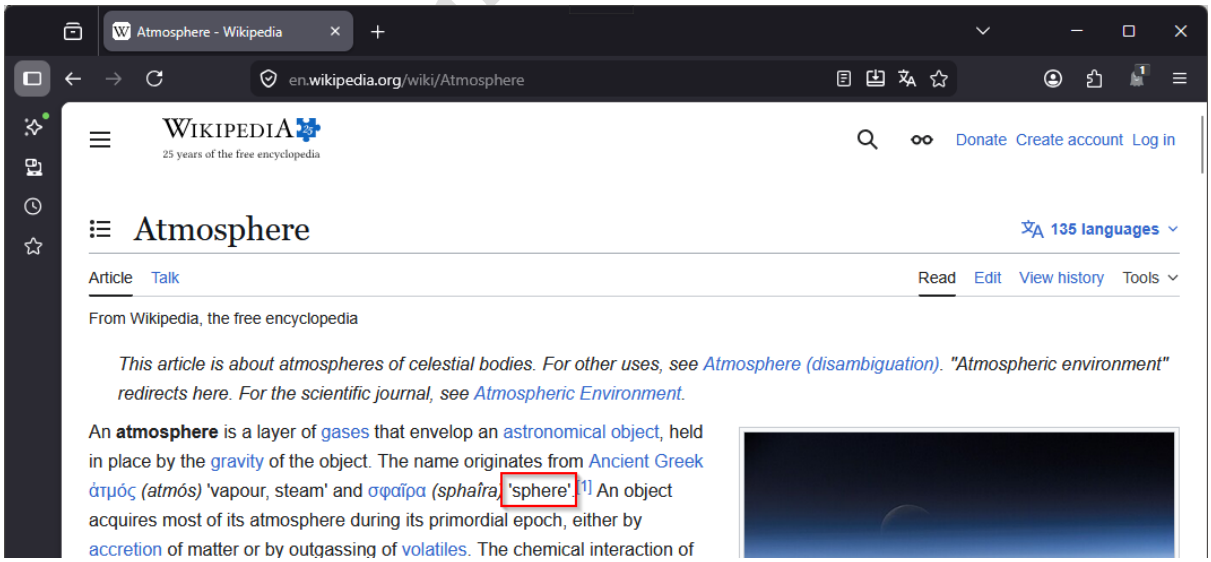
(#244) The word "atmosphere" implies a... sphere

Both proponents of the flat Earth and those of the oblate Earth use the word *Atmosphere*.. However, this word directly implies that the atmos has the shape of a sphere.

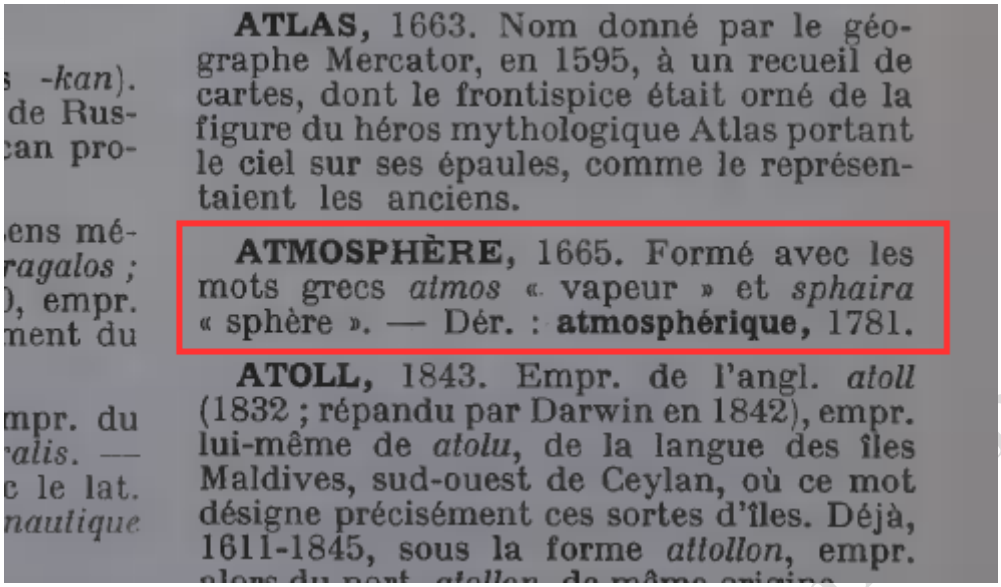
Let's look at the etymology of this word on the French website of the National Center for Textual and Lexical Resources (https://www.cnrtl.fr). We then have as first source:

Where the text surrounded in red means in english: “(celestial) sphere”.

The same applies to Wikipedia (https://en.wikipedia.org/wiki/Atmosphere) as a second source:


Atmosphere - Wikipedia
en.wikipedia.org/wiki/Atmosphere
WIKIPEDIA
25 years of the free encyclopedia
Donate
Create account
Log in
Atmosphere
135 languages
Article
Talk
Read
Edit
View history
Tools
From Wikipedia, the free encyclopedia
This article is about atmospheres of celestial bodies. For other uses, see Atmosphere (disambiguation). "Atmospheric environment" redirects here. For the scientific journal, see Atmospheric Environment.
An atmosphere is a layer of gases that envelop an astronomical object, held in place by the gravity of the object. The name originates from Ancient Greek ἀτμός (atmós) 'vapour, steam' and σφαῖρα (sphaîra) 'sphere'.[1] An object acquires most of its atmosphere during its primordial epoch, either by accretion of matter or by outgassing of volatiles. The chemical interaction of

Or a third source, which is the *Etymological Dictionary of the French Language* by Oscar Bloch, W. von Wartburg, published by Presses Universitaires de France (1964):



-kan).
de Rus-
can pro-

ens mé-
ragalos ;
), empr.
ment du

mpr. du
ralis. —
c le lat.
nautique

ATLAS, 1663. Nom donné par le géographe Mercator, en 1595, à un recueil de cartes, dont le frontispice était orné de la figure du héros mythologique Atlas portant le ciel sur ses épaules, comme le représentaient les anciens.

ATMOSPHÈRE, 1665. Formé avec les mots grecs *atmos* « vapeur » et *sphaira* « sphère ». — Dér. : **atmosphérique,** 1781.

ATOLL, 1843. Empr. de l'angl. *atoll* (1832 ; répandu par Darwin en 1842), empr. lui-même de *atolu*, de la langue des îles Maldives, sud-ouest de Ceylan, où ce mot désigne précisément ces sortes d'îles. Déjà, 1611-1845, sous la forme *atollon*, empr.

The translation into english gives: "*ATMOSPHERE, 1665. Formed from the Greek words atmos "vapor" and sphaira "sphere". — Der.: atmospheric, 1781.*"

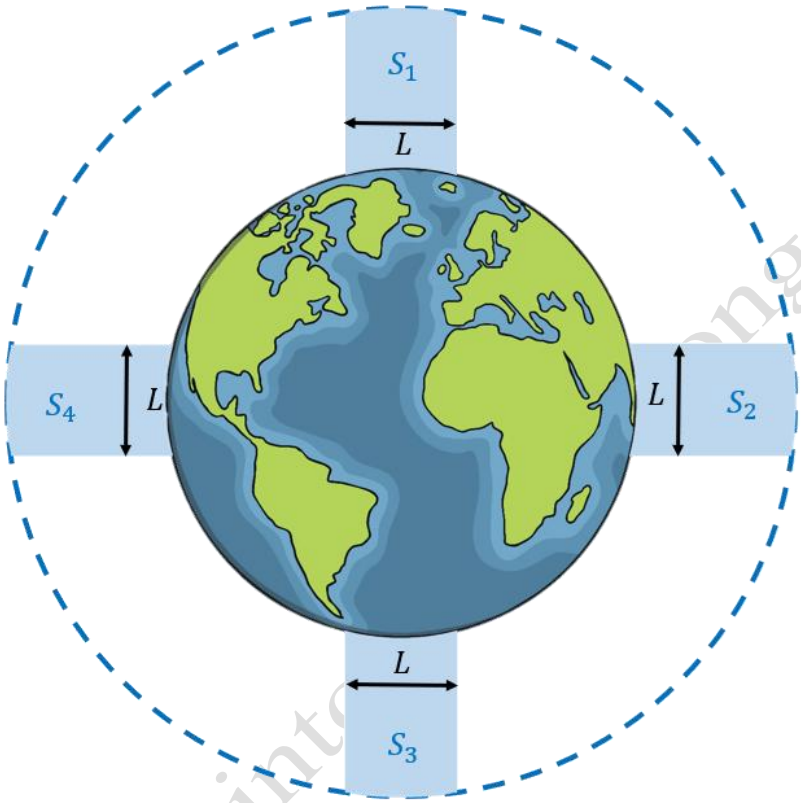
So, using the word "atmosphere" implies that the atmosphere forms a sphere. Therefore, proponents of the flat Earth theory know that the atmosphere forms a sphere because it follows the shape of the Earth…

translation into english ong

(#245) Atmospheric pressure

Atmospheric pressure on an oblate Earth is consistent. But life on a flat Earth would be uninhabitable.

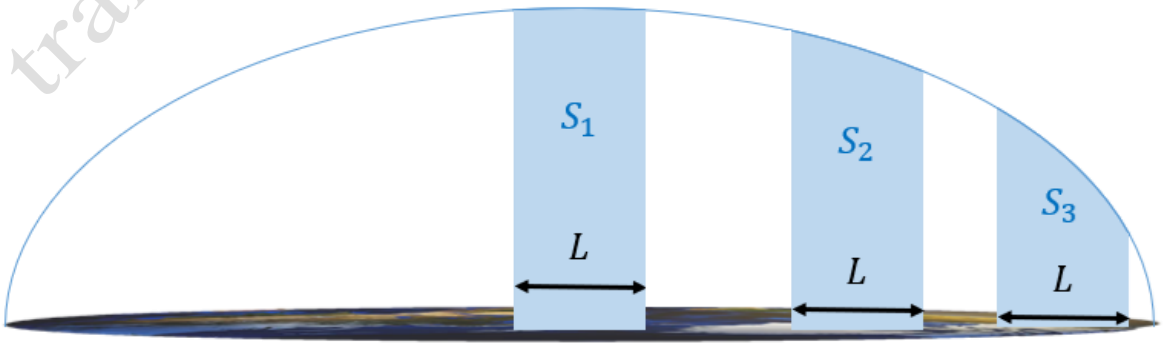
Indeed, on a globe:



$$S_1 = S_2 = S_3 = S_4$$

The pressure is constant because we have the same amount of air for each column of the same surface area.

On a flat Earth with the famous dome of the eleven Abrahamic religions:



translation into ongoing

$$S_1 \neq S_2 \neq S_3$$

Therefore, the pressure is not constant because we do not have the same amount of air for each column of the same surface area.

Non-constant density and temperature! Uninhabitable in the Southern Hemisphere.

translation into english ongoing

Gravity waves (volcanic eruptions)

(#246) Tonga volcano in 2022

In fluid mechanics, a gravity wave is defined as a wave moving on the free surface of a fluid subjected to gravity.

In oceanography, waves in open environments or sloshing in closed environments are examples of gravity waves.

In meteorology, we observe gravity waves created by the fall of a mass of air (for example downwind of a terrain) which is subject to Archimedes' principle because it has a higher density than the surrounding air.

The 2022 Hunga Tonga eruption was a major volcanic eruption that occurred between January 14 and 15, 2022, on the volcanic island of Hunga Tonga-Hunga Ha'apai in the Tonga archipelago.

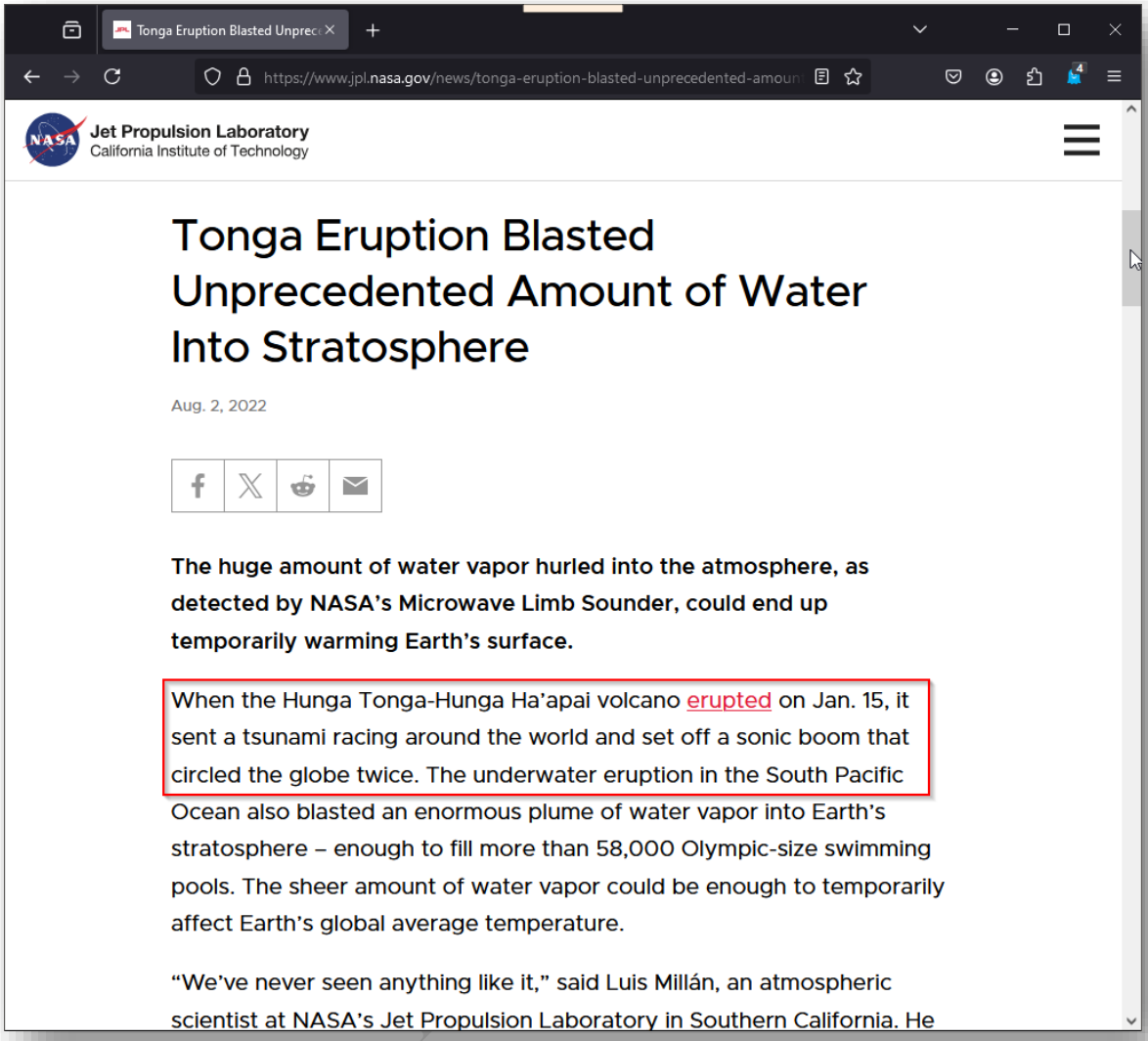
According to scientists, the eruption produced the highest volcanic plume ever recorded with modern instruments, reaching 57 kilometers in height.

Below, we provide links to videos of the gravity shockwave from the Hunga Tonga eruption, captured by GOES-17 (GOES-West) and illustrated via intermediate-level steam channel imagery. Detonations were also heard across New Zealand and as far away as Yukon in northern Canada.

According to NASA's JPL center, the eruption — on January 15, 2022 — created a "sonic boom that circled the globe twice" and the shock wave rebounded (and this was observed by satellites) at the antipodal point of the Earth, which is obviously impossible for a flat Earth (Gravity waves generated by the Hunga Tonga--Hunga Ha′ apai volcanic eruption and their global propagation in the mesosphere/lower thermosphere observed by meteor radars and modeled with the High-Altitude general Mechanistic Circulation Model, 2024).

https://www.jpl.nasa.gov/news/tonga-eruption-blasted-unprecedented-amount-of-water-into-stratosphere/

translation into english ongoing



Jet Propulsion Laboratory
California Institute of Technology

Tonga Eruption Blasted Unprecedented Amount of Water Into Stratosphere

Aug. 2, 2022

The huge amount of water vapor hurled into the atmosphere, as detected by NASA's Microwave Limb Sounder, could end up temporarily warming Earth's surface.

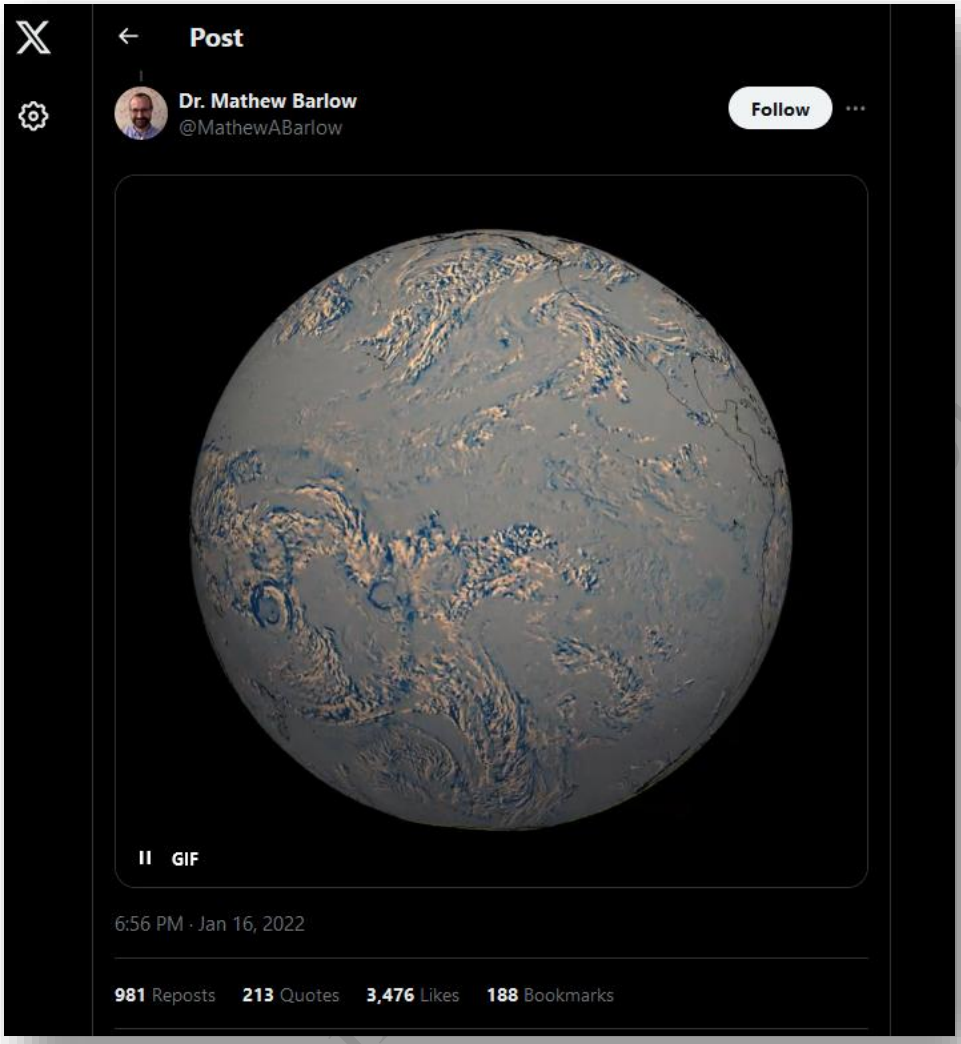
When the Hunga Tonga-Hunga Ha'apai volcano erupted on Jan. 15, it sent a tsunami racing around the world and set off a sonic boom that circled the globe twice. The underwater eruption in the South Pacific Ocean also blasted an enormous plume of water vapor into Earth's stratosphere – enough to fill more than 58,000 Olympic-size swimming pools. The sheer amount of water vapor could be enough to temporarily affect Earth's global average temperature.

"We've never seen anything like it," said Luis Millán, an atmospheric scientist at NASA's Jet Propulsion Laboratory in Southern California. He

It was also recorded by meteorological stations in Australia. A fluctuation in atmospheric pressure of 2.5 hPa was also measured in Switzerland and in the Var region of France. Shock waves were measured, a scientific first, at an altitude of 20 km using stratospheric pressurized balloons from the CNRS and CNES Strateole 2 campaign. Located at 2,000 and 7,600 m respectively, these two balloons had not yet descended as the campaign drew to a close. The plume's upward thrust in the atmosphere generated gravity waves reaching the theoretically predicted maximum speed in the troposphere and stratosphere, and even a record speed of 667 m/s in the ionosphere.

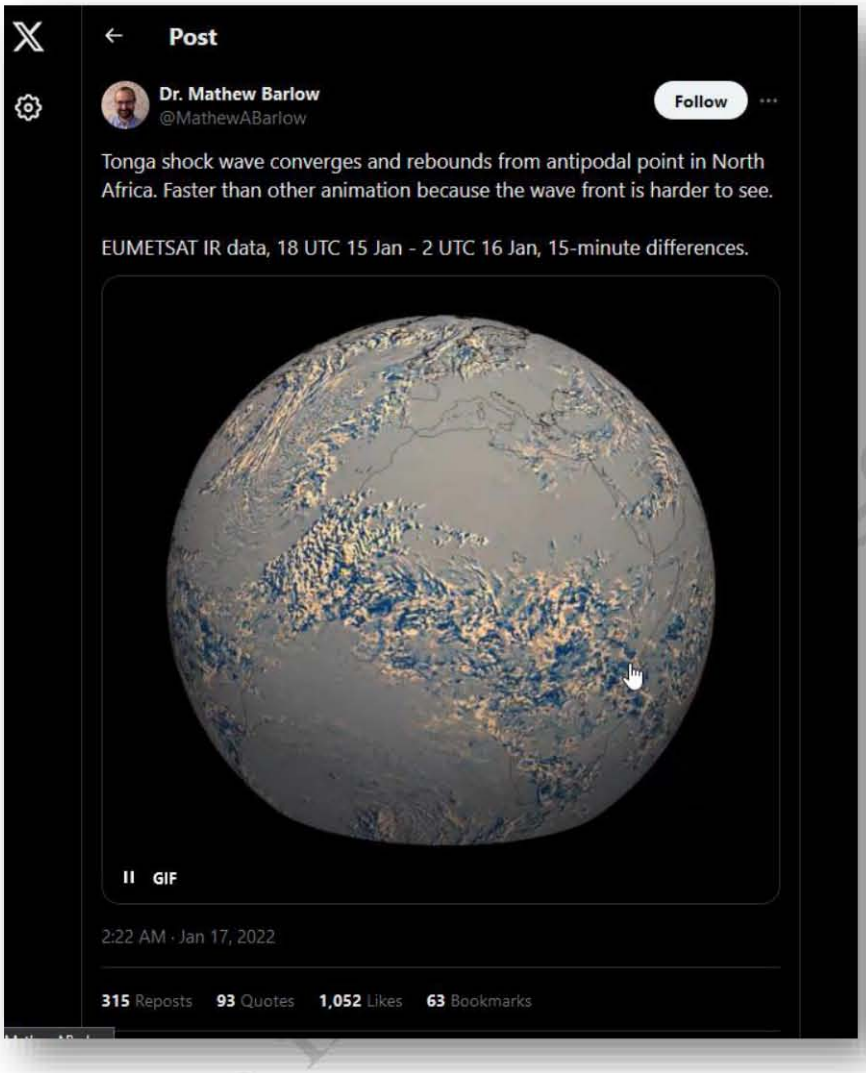
An animation taken from a satellite over the Pacific Ocean shows the site of the explosion in Tonga and the shock wave spreading in concentric circles around the globe. As the shock wave propagates, it can be seen weakening.

https://x.com/MathewABarlow/status/1482773777410891779



A second animation uses a satellite over Africa. It shows the shock wave converging towards the other side of the world. The eruption occurred at 20.550° South latitude and 175.385° West longitude. The antipodal point on the other side of the world is therefore at 20.550° North latitude and 4.615° East longitude, in southern Algeria. And in this video, you can see the shock wave converge towards this point in Algeria, then spread out again, producing the second wave that was later recorded in Oxford (this animation is sped up compared to the first animation, to make it easier to visualize the propagation of the shock wave, as it is significantly weaker and more difficult to see at a slower speed):

https://x.com/MathewABarlow/status/1482886104747544576


Post
Dr. Mathew Barlow
@MathewABarlow
Follow
Tonga shock wave converges and rebounds from antipodal point in North Africa. Faster than other animation because the wave front is harder to see.
EUMETSAT IR data, 18 UTC 15 Jan - 2 UTC 16 Jan, 15-minute differences.
GIF
2:22 AM · Jan 17, 2022
315 Reposts 93 Quotes 1,052 Likes 63 Bookmarks

translation in progress

(#247) Krakatoa volcano in 1883

The eruption of Krakatoa in 1883 generated an atmospheric pressure wave that circled the Earth several times and was recorded by barometers worldwide. The fact that this wave could periodically return to the same observation points demonstrates that the Earth is a closed globe, and not an infinitely flat surface.

Why the Krakatoa wave proves the Earth's sphericity:

- **Gigantic explosion:** On August 27, 1883, the eruption of Krakatoa produced the loudest detonation ever recorded, heard up to 3,000 km away (Australia, Mauritius).
- **Global pressure wave:** Barometers around the world recorded an atmospheric wave that propagated around the globe. It was detected seven times in Glasgow, at regular intervals, which corresponds to several circumnavigations of the wave (Robert Henry Scott).
- **Circular propagation:** The only way to explain these periodic returns is that the wave was traveling over a closed, curved surface — in other words, the Earth is spherical! On a flat Earth, the wave would dissipate without returning in a regular pattern.
- **Scientific confirmation:** The Royal Society report (Symons, 1888) showed that the wave had circled the globe in about 36 hours, returning several times to the same stations.

Key points:

- **Duration of the complete circuit:** The pressure wave took approximately 36 hours to travel around the Earth's circumference.
- **Number of passes:** The instruments recorded up to seven successive East to West passes, evidence of propagation over a sphere (globe).
- **Consequently:** This constitutes empirical proof that the Earth is a globe, since only a closed surface allows for such a repetitive and regular phenomenon that always moves in the same direction.

Here are the measurements published in 1883 (Robert Henry Scott) :

translation into english ongoing

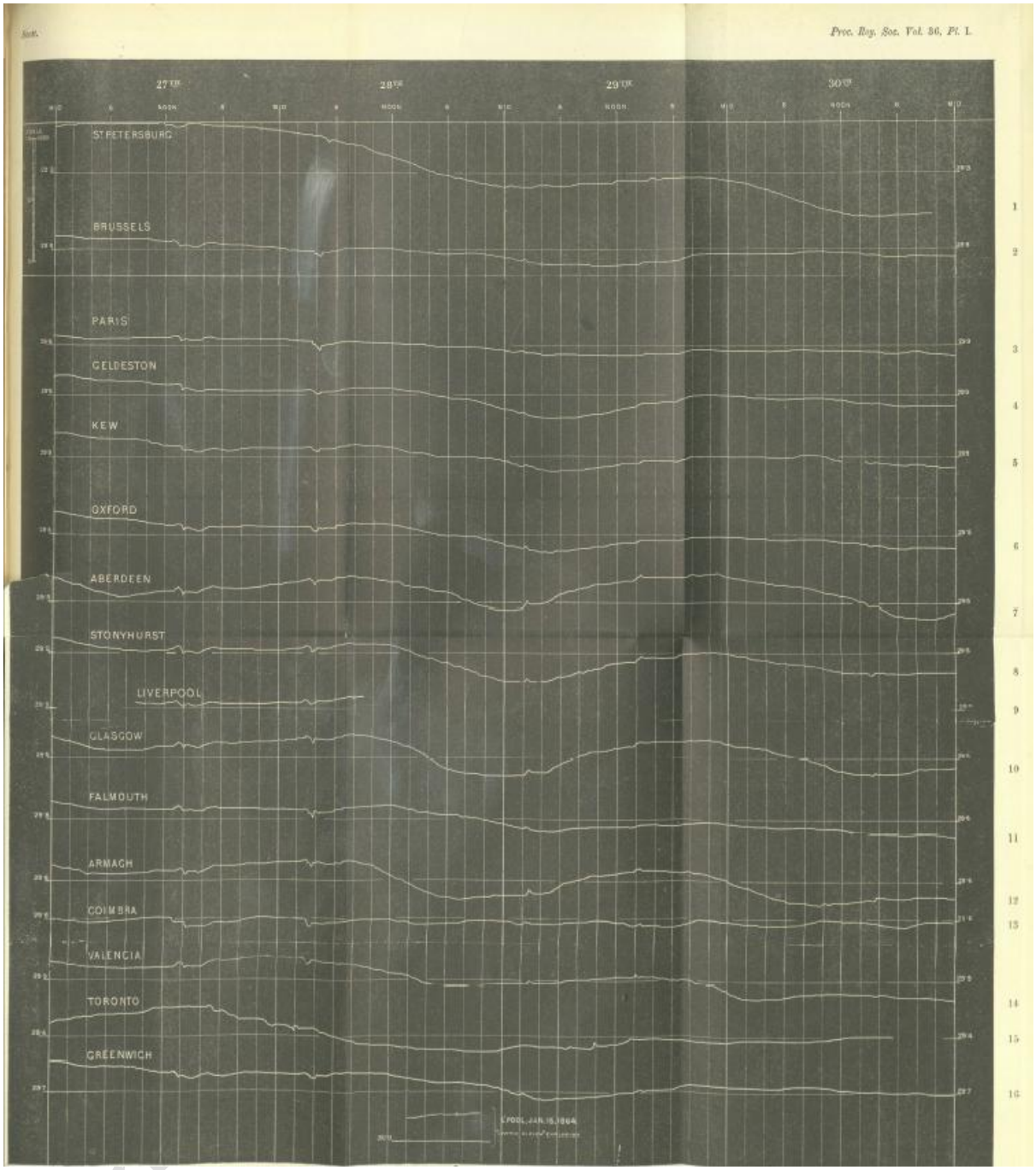
Times of Commencement of the Barometrical Oscillations at the under-mentioned Stations, August 27th, 28th, and 29th, 1883.

Stations.	(1st.) August 27th.			(2nd.) August 28th.		(3rd.) Aug. 29th.		(4th.) Aug. 29th.		Amplitude of the Oscillation.			
	P.M.	P.M.	P.M.	A.M.	A.M.	A.M.	A.M.	P.M.	P.M.	(1st.) inch.	(2nd.) inch.	(3rd.) inch.	(4th.) inch.
St. Petersburg	11 5 (A.M.)	11 35 (A.M.)	0 0	4 40	5 15	0 20	1 0	3	3 35	0·040	0·024	0·012	0·034
Brussels	0 33	0 58	1 30	3 48	4 28	1 43	2 8	2 23	2 43	·051	·039	·039	·017
Geldeston	0 42	1 12	1 40	3 10	4 7	1 40	2 2	2 14	2 44	·060	·040	·035	·010
Kew	0 50	1 10	1 47	3 10	4 5	1 45	2 13	2 0	2 43	·049	·051	·024	·011
Oxford	0 53	1 23	1 50	3 0	3 57	1 55	2 15	1 53	2 40	·030	·030	·015	·015
Aberdeen	1 0	1 25	1 53	3 10	3 52	1 50	2 33	1 53	2 30	·062	·052	·046	·036
Stonyhurst	1 0	1 28	1 55	2 57	3 45	2 0	2 27	1 48	2 33	·062	·064	·029	·050
Glasgow	0 58	1 35	2 5	3 0	3 45	2 10	2 37	1 42	2 27	·046	·064	·050	·028
Falmouth	1 7	1 35	2 5	2 57	3 45	2 5	2 25	1 20	2 28	·050	·080	·030	·030
Armagh	1 13	1 45	2 12	2 53	3 33	2 20	2 45	1 46	2 22	·049	·062	·029	·036
Valencia	1 20	1 48	2 25	2 30	3 20	2 28	2 50	1 27	2 10	·060	·070	·040	·040
Coimbra	..	1 50	2 20	3 5	3 15	2 10	2 15	2 10	2 35	0·066	0·043	0·043	0·043

NOTE.—The figures in antique type indicate a *rise* of the barometer, those in ordinary type a *fall*.

And here are the graphs of the different barometric measurements from the different measuring stations (Robert Henry Scott):

translation into englis



With propagation times and a propagation direction that are compatible with a globe but incompatible with a flat Earth:

I. At about 11 h. A.M. on the 27th, a sudden increase of pressure, followed by a decrease, appeared at St. Petersburg, and a similar phenomenon was noticed at Valencia Island, and at Coimbra in Portugal, as well as at all the intermediate observatories over Europe from which we have been able to obtain tracings of barograms.

The character of the disturbance was not strictly identical, for at the western stations the rise of the barometer was more marked than at the eastern. The general appearance of the barograms at adjacent stations is strikingly similar. It is, however, difficult to select any peculiarly remarkable phase of the disturbance so as to recognise it and record the time of its occurrence at each observatory.

This movement (I) was propagated from east to west at a very high velocity, for the recovery of pressure from the first decrease occurred at St. Petersburg at noon, and at Valencia at 2 h. 25 m. P.M. on the same day, thus taking only two hours and twenty-five minutes to traverse the distance of 1,315 miles between the two observatories.

II. A somewhat similar disturbance appeared on the 28th, but was propagated from west to east, reaching Valencia at 3 h. 20 m. A.M., and St. Petersburg at 5 h. 15 m. A.M., and thus requiring only one hour and fifty-five minutes for its passage. The same uncertainty as to identification of the phase exists in this case as in the preceding. In all cases, however, the most marked phase of the phenomenon has been noted.

III. A disturbance travelling in the same general direction as No. I.

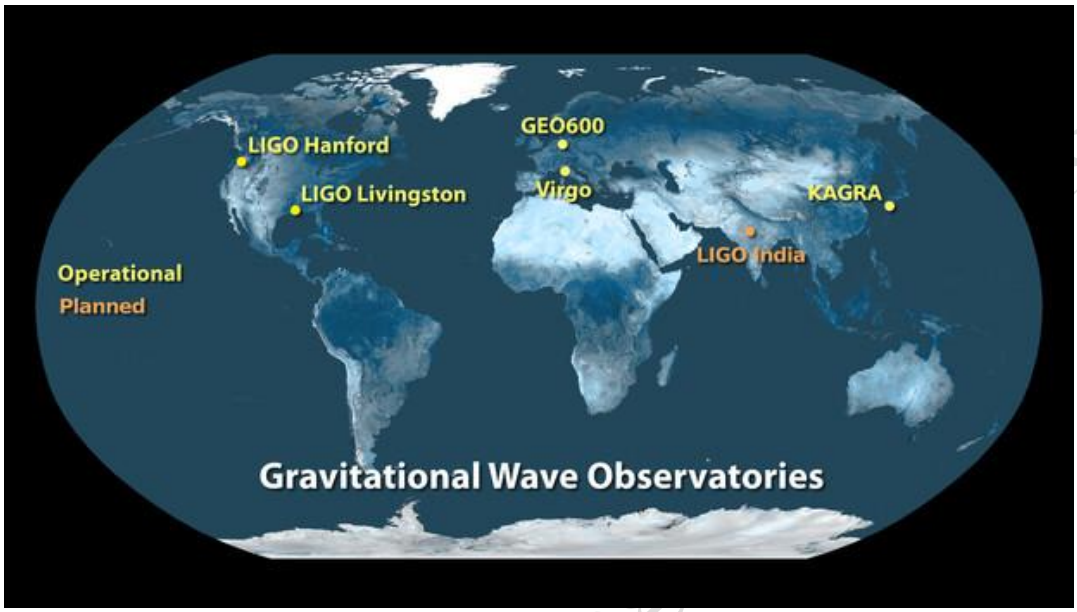
As this part confirms:

II. Note on the foregoing Paper. By Lieutenant-General R. STRACHEY, F.R.S. Received December 12, 1883.

The obvious correspondence of the forms and times of occurrence of the barometric disturbances, described in Mr. Scott's paper, at once suggested that they were due to a common origin, and the great volcanic eruption at Krakatoa in the Straits of Sunda appeared to supply a probable efficient cause. Any shock of sufficient violence might be expected to produce an atmospheric wave, advancing from the place where it was caused in a circular form round the globe, at first expanding until it had got half round the earth, and then again contracting till it was again concentrated at the antipodes, from which again it would be thrown back, and so pass backwards and forwards till it was obliterated. It might also have been expected that such a wave would travel with the velocity of sound, being probably of the same nature as that which causes sound, though the vibrations had not the peculiar character that affects our organs of hearing. It has, however, been suggested to me that the wave may rather have had the character of a solitary wave produced in a liquid, the velocity of which in the air would not materially differ from that of sound.

LIGO gravitational wave detectors

The LASER Interferometer Gravitational-Wave Observatory, abbreviated LIGO, is a worldwide physics experiment (LIGO Hanford/USA, LIGO Livingston/USA, GEO600/Germany, Virgo/Italy) whose goal is to directly detect gravitational waves.



Two facts related to LIGO proves that the Earth is not flat!

translation into eng

(#248) Taking curvature into account in the construction of Caltech's LIGO

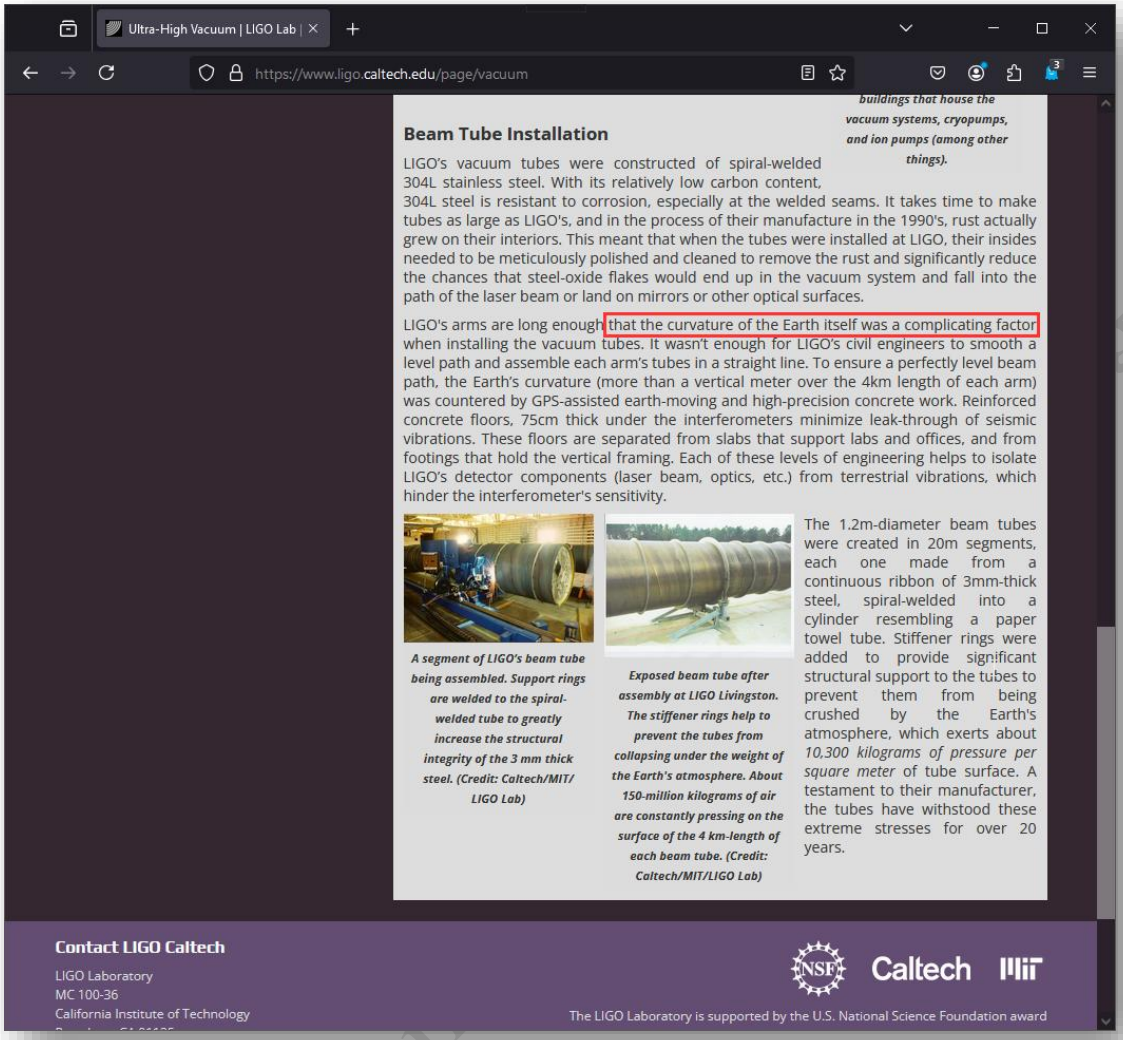
Caltech's LIGO arms are so long that the curvature of the Earth is measurable from 1 meter (vertically) over the 4 km length of each arm.

Figure 136 LIGO interferometer at Caltech (Livingston, Washington, USA)

As confirmed on the LIGO website:

https://www.ligo.caltech.edu/page/vacuum

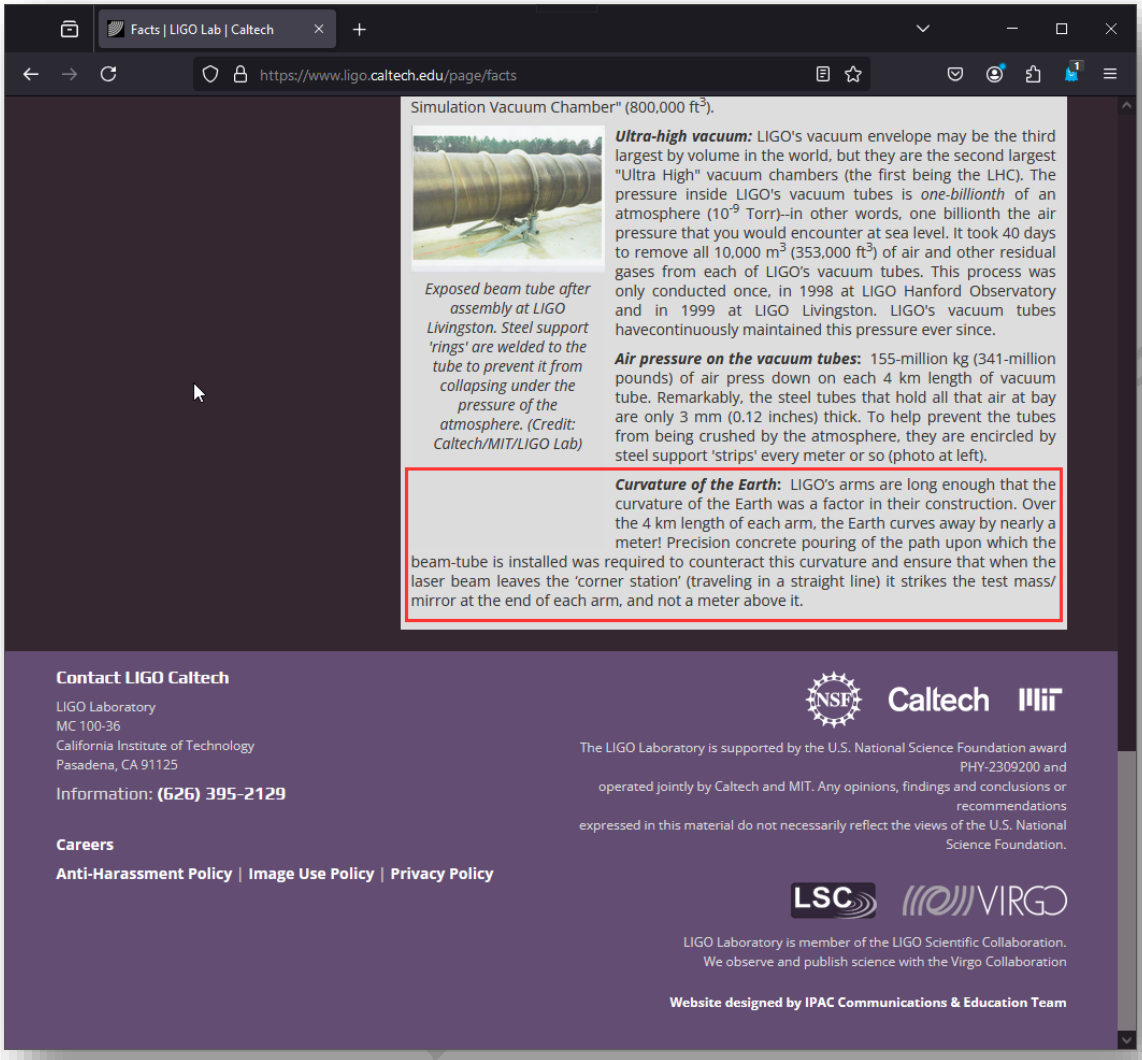
translation into English


Ultra-High Vacuum | LIGO Lab |
https://www.ligo.caltech.edu/page/vacuum
buildings that house the vacuum systems, cryopumps, and ion pumps (among other things).
Beam Tube Installation
LIGO's vacuum tubes were constructed of spiral-welded 304L stainless steel. With its relatively low carbon content, 304L steel is resistant to corrosion, especially at the welded seams. It takes time to make tubes as large as LIGO's, and in the process of their manufacture in the 1990's, rust actually grew on their interiors. This meant that when the tubes were installed at LIGO, their insides needed to be meticulously polished and cleaned to remove the rust and significantly reduce the chances that steel-oxide flakes would end up in the vacuum system and fall into the path of the laser beam or land on mirrors or other optical surfaces.
LIGO's arms are long enough that the curvature of the Earth itself was a complicating factor when installing the vacuum tubes. It wasn't enough for LIGO's civil engineers to smooth a level path and assemble each arm's tubes in a straight line. To ensure a perfectly level beam path, the Earth's curvature (more than a vertical meter over the 4km length of each arm) was countered by GPS-assisted earth-moving and high-precision concrete work. Reinforced concrete floors, 75cm thick under the interferometers minimize leak-through of seismic vibrations. These floors are separated from slabs that support labs and offices, and from footings that hold the vertical framing. Each of these levels of engineering helps to isolate LIGO's detector components (laser beam, optics, etc.) from terrestrial vibrations, which hinder the interferometer's sensitivity.
A segment of LIGO's beam tube being assembled. Support rings are welded to the spiral-welded tube to greatly increase the structural integrity of the 3 mm thick steel. (Credit: Caltech/MIT/LIGO Lab)
Exposed beam tube after assembly at LIGO Livingston. The stiffener rings help to prevent the tubes from collapsing under the weight of the Earth's atmosphere. About 150-million kilograms of air are constantly pressing on the surface of the 4 km-length of each beam tube. (Credit: Caltech/MIT/LIGO Lab)
The 1.2m-diameter beam tubes were created in 20m segments, each one made from a continuous ribbon of 3mm-thick steel, spiral-welded into a cylinder resembling a paper towel tube. Stiffener rings were added to provide significant structural support to the tubes to prevent them from being crushed by the Earth's atmosphere, which exerts about 10,300 kilograms of pressure per square meter of tube surface. A testament to their manufacturer, the tubes have withstood these extreme stresses for over 20 years.
Contact LIGO Caltech
LIGO Laboratory
MC 100-36
California Institute of Technology
NSF
Caltech
MIT
The LIGO Laboratory is supported by the U.S. National Science Foundation award

Also here :

https://www.ligo.caltech.edu/page/facts

translation


Facts | LIGO Lab | Caltech
https://www.ligo.caltech.edu/page/facts
Simulation Vacuum Chamber" (800,000 ft3).
Exposed beam tube after assembly at LIGO Livingston. Steel support 'rings' are welded to the tube to prevent it from collapsing under the pressure of the atmosphere. (Credit: Caltech/MIT/LIGO Lab)
Ultra-high vacuum: LIGO's vacuum envelope may be the third largest by volume in the world, but they are the second largest "Ultra High" vacuum chambers (the first being the LHC). The pressure inside LIGO's vacuum tubes is one-billionth of an atmosphere (10-9 Torr)--in other words, one billionth the air pressure that you would encounter at sea level. It took 40 days to remove all 10,000 m3 (353,000 ft3) of air and other residual gases from each of LIGO's vacuum tubes. This process was only conducted once, in 1998 at LIGO Hanford Observatory and in 1999 at LIGO Livingston. LIGO's vacuum tubes havecontinuously maintained this pressure ever since.
Air pressure on the vacuum tubes: 155-million kg (341-million pounds) of air press down on each 4 km length of vacuum tube. Remarkably, the steel tubes that hold all that air at bay are only 3 mm (0.12 inches) thick. To help prevent the tubes from being crushed by the atmosphere, they are encircled by steel support 'strips' every meter or so (photo at left).
Curvature of the Earth: LIGO's arms are long enough that the curvature of the Earth was a factor in their construction. Over the 4 km length of each arm, the Earth curves away by nearly a meter! Precision concrete pouring of the path upon which the beam-tube is installed was required to counteract this curvature and ensure that when the laser beam leaves the 'corner station' (traveling in a straight line) it strikes the test mass/ mirror at the end of each arm, and not a meter above it.
Contact LIGO Caltech
LIGO Laboratory
MC 100-36
California Institute of Technology
Pasadena, CA 91125
Information: (626) 395-2129
Careers
Anti-Harassment Policy | Image Use Policy | Privacy Policy
NSF
Caltech
MIT
The LIGO Laboratory is supported by the U.S. National Science Foundation award PHY-2309200 and operated jointly by Caltech and MIT. Any opinions, findings and conclusions or recommendations expressed in this material do not necessarily reflect the views of the U.S. National Science Foundation.
LSC
VIRGO
LIGO Laboratory is member of the LIGO Scientific Collaboration. We observe and publish science with the Virgo Collaboration
Website designed by IPAC Communications & Education Team

The construction of the LIGO interferometer at Caltech therefore required taking into account the curvature of the Earth, and therefore the latter is not flat!

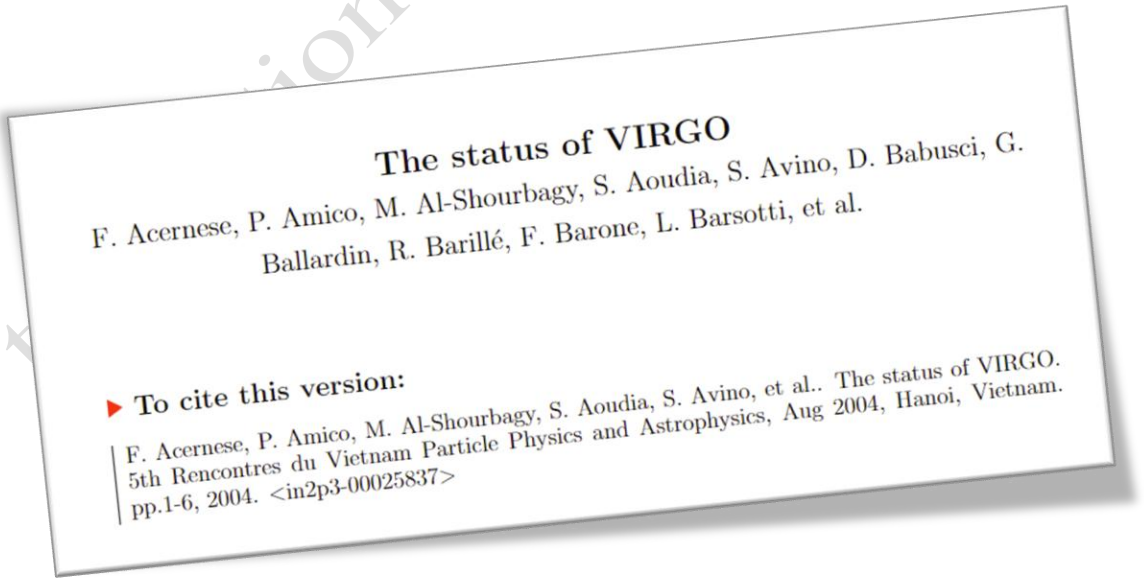
translation

(#249) Taking curvature into account in the construction of VIRGO'S LIGO

VIRGO'S LIGO arms are so long that the curvature of the Earth is measurable by about 1 meter (vertically) over the 3 km length of each arm.

Figure 137 VIRGO interferometer (Pisa/Italy)

As confirmed in the document establishing VIRGO's status:



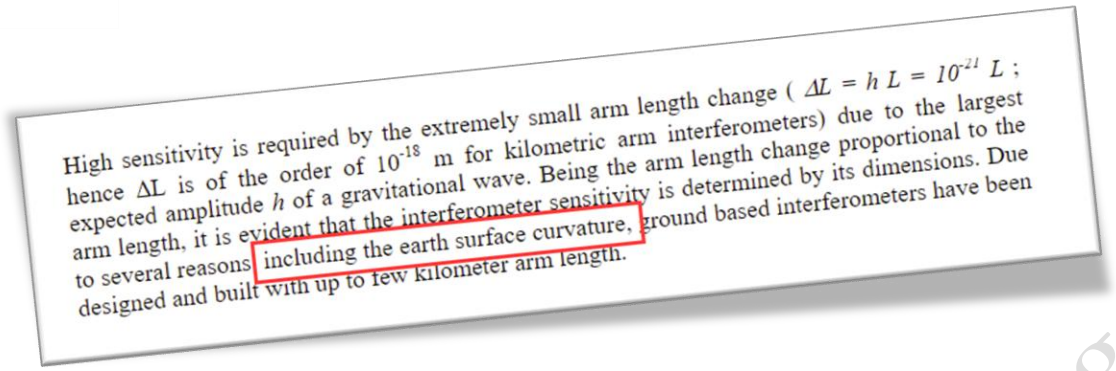
The status of VIRGO

F. Acernese, P. Amico, M. Al-Shourbagy, S. Aoudia, S. Avino, D. Babusci, G. Ballardin, R. Barillé, F. Barone, L. Barsotti, et al.

To cite this version:

F. Acernese, P. Amico, M. Al-Shourbagy, S. Aoudia, S. Avino, et al.. The status of VIRGO. 5th Rencontres du Vietnam Particle Physics and Astrophysics, Aug 2004, Hanoi, Vietnam. pp.1-6, 2004. <in2p3-00025837>

We have :



High sensitivity is required by the extremely small arm length change ($\Delta L = h\,L = 10^{-21}\,L$; hence ΔL is of the order of 10^{-18} m for kilometric arm interferometers) due to the largest expected amplitude h of a gravitational wave. Being the arm length change proportional to the arm length, it is evident that the interferometer sensitivity is determined by its dimensions. Due to several reasons including the earth surface curvature, ground based interferometers have been designed and built with up to few kilometer arm length.

The construction of the VIRGO's interferometer therefore required taking into account the curvature of the Earth, and therefore the latter is not flat.

translation into english ongoing

(#250) Taking curvature into account in the construction of VIRGO'S Kamioka

The LIGO arms of KAGRA (Kamioka Gravitational Wave Detector) are so long that the curvature of the Earth is measurable by about 1 meter (vertically) over the 3 kilometers length of each arm.

Figure 138 KAGRA underground interferometer (Kamioka/Japan)

As confirmed in the document dealing with a problem of cracks on the detector due to the curvature of the Earth:

translation in

Version of Record: https://www.sciencedirect.com/science/article/pii/S0375960121005284
Manuscript_860b82f8111f67c9070f337964116c53

Investigation of crackling noise in the vibration isolation systems of the KAGRA gravitational wave detector

Yuhang Zhao[a,b,c,*], Shin Kirii[a], Yingtao Liu[a], Takashi Uchiyama[a], Ryutaro Takahashi[c], Seiji Kawamura[a,d]

[a] *KAGRA Observatory, ICRR, The University of Tokyo, Hida, Gifu 506-1205, Japan*
[b] *Department of Astronomy, Beijing Normal University, Beijing 100875, China*
[c] *Gravitational Wave Science Project, National Astronomical Observatory of Japan, Mitaka. Tokyo 181-8588, Japan*
[d] *Division of Particle and Astrophysical Sciences, Nagoya University, Nagoya, Aichi, 464-8602, Japan*

Abstract

As this part confirms it:

4.1. Measurement direction of mirror displacement

Crackling noise of GAS causes displacement noise in the vertical direction. In CNMS, the modified Michelson interferometer directly detects this vertical displacement noise. In KAGRA, even though we nominally measure the horizontal displacement of test masses, figure 5 shows that there is horizontal-to-vertical coupling due to the curvature of the Earth and ground tilt. The ground tilt of the KAGRA arm tunnel is 1/300 ($= 3.33\times10^{-3}$), and the difference between the optical axis and the horizontal axis due to the curvature of the Earth is 0.24×10^{-3}. Therefore, in the worst case, the coupling from vertical displace-

9

(#251) Taking curvature into account in the Einstein Telescope construction project

The Einstein Telescope is a third-generation gravitational-wave detector project currently under development by several European institutions. This telescope will be capable of testing Einstein's theory of General Relativity under strong field conditions and performing high-precision gravitational-wave astronomy.

Its construction should begin in 2026 and its first observations should be carried out in 2035; the arms of the interferometer will be **10kilometers long**!

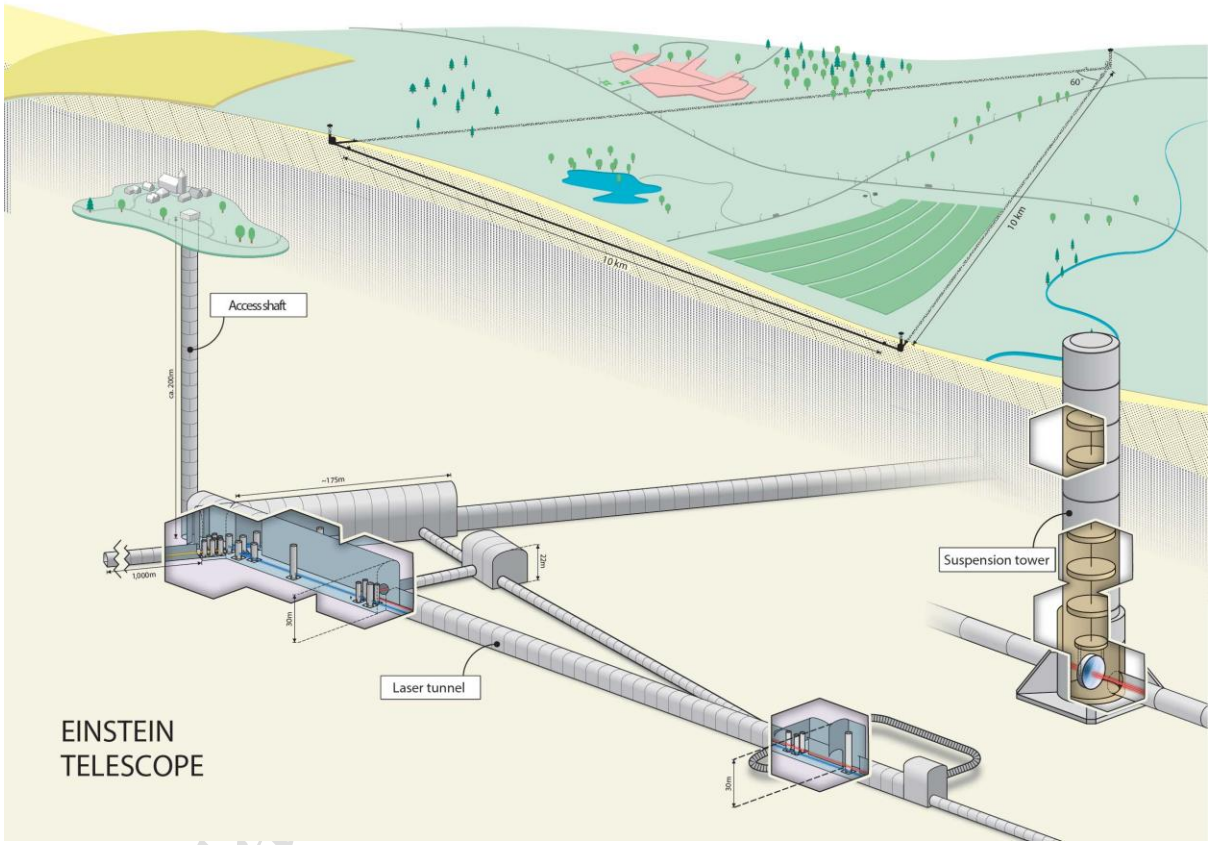
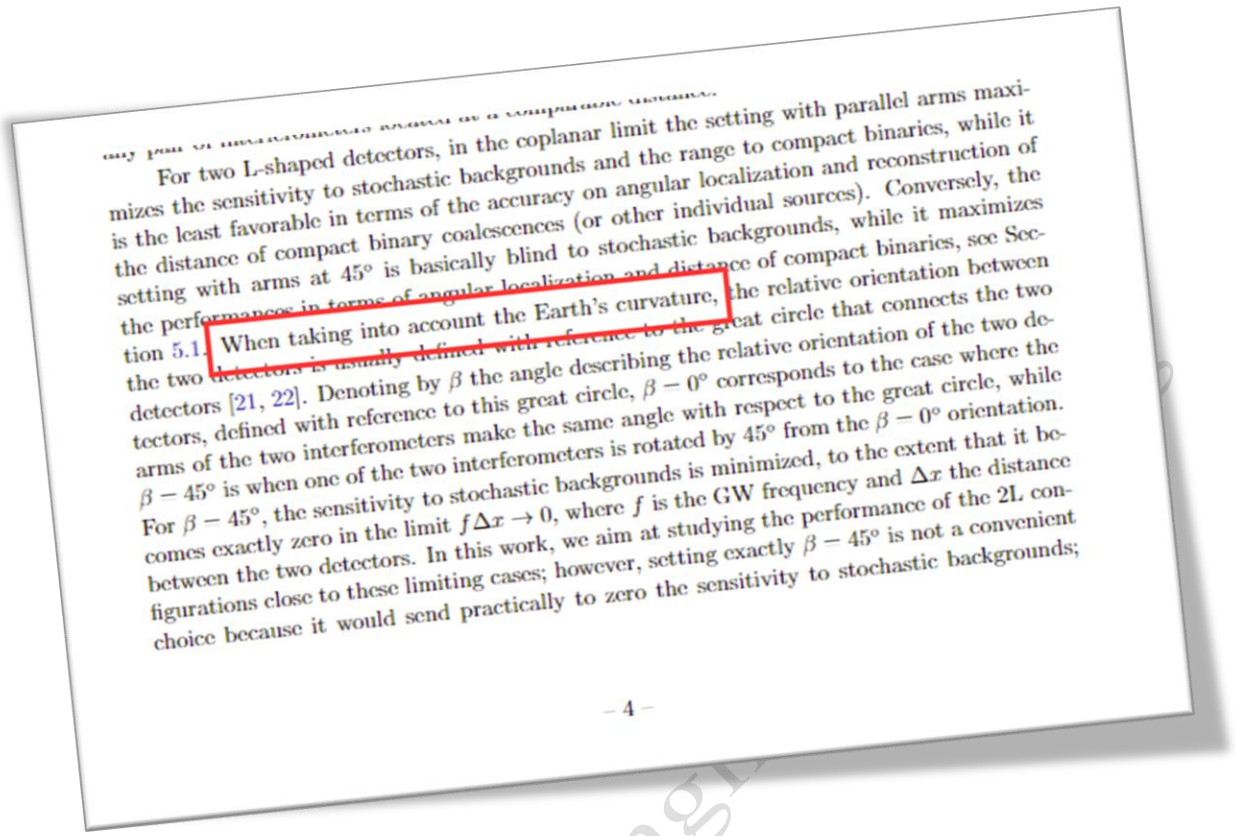


Figure 139 Artist's rendering of the future Einstein telescope

As stated in the 199-page feasibility report "*Science with the Einstein Telescope: a comparison of different designs*" for the project, available here on the CERN server:

https://cds.cern.ch/record/2855729/files/2303.15923.pdf

where several times it is mentioned that the issue of the Earth's curvature must be taken into account or addressed:



For two L-shaped detectors, in the coplanar limit the setting with parallel arms maximizes the sensitivity to stochastic backgrounds and the range to compact binaries, while it is the least favorable in terms of the accuracy on angular localization and reconstruction of the distance of compact binary coalescences (or other individual sources). Conversely, the setting with arms at 45° is basically blind to stochastic backgrounds, while it maximizes the performances in terms of angular localization and distance of compact binaries, see Section 5.1. When taking into account the Earth's curvature, the relative orientation between the two detectors is usually defined with reference to the great circle that connects the two detectors [21, 22]. Denoting by β the angle describing the relative orientation of the two detectors, defined with reference to this great circle, $\beta = 0°$ corresponds to the case where the arms of the two interferometers make the same angle with respect to the great circle, while $\beta = 45°$ is when one of the two interferometers is rotated by 45° from the $\beta = 0°$ orientation. For $\beta = 45°$, the sensitivity to stochastic backgrounds is minimized, to the extent that it becomes exactly zero in the limit $f\Delta x \to 0$, where f is the GW frequency and Δx the distance between the two detectors. In this work, we aim at studying the performance of the 2L configurations close to these limiting cases; however, setting exactly $\beta = 45°$ is not a convenient choice because it would send practically to zero the sensitivity to stochastic backgrounds;

– 4 –

We also have here an article that details the use of LASER for aligning CERN's particle accelerators:

https://link.springer.com/chapter/10.1007/978-94-011-1564-3_2

translation into engl

(#252) Taking curvature into account in the Cosmic Explorer construction project

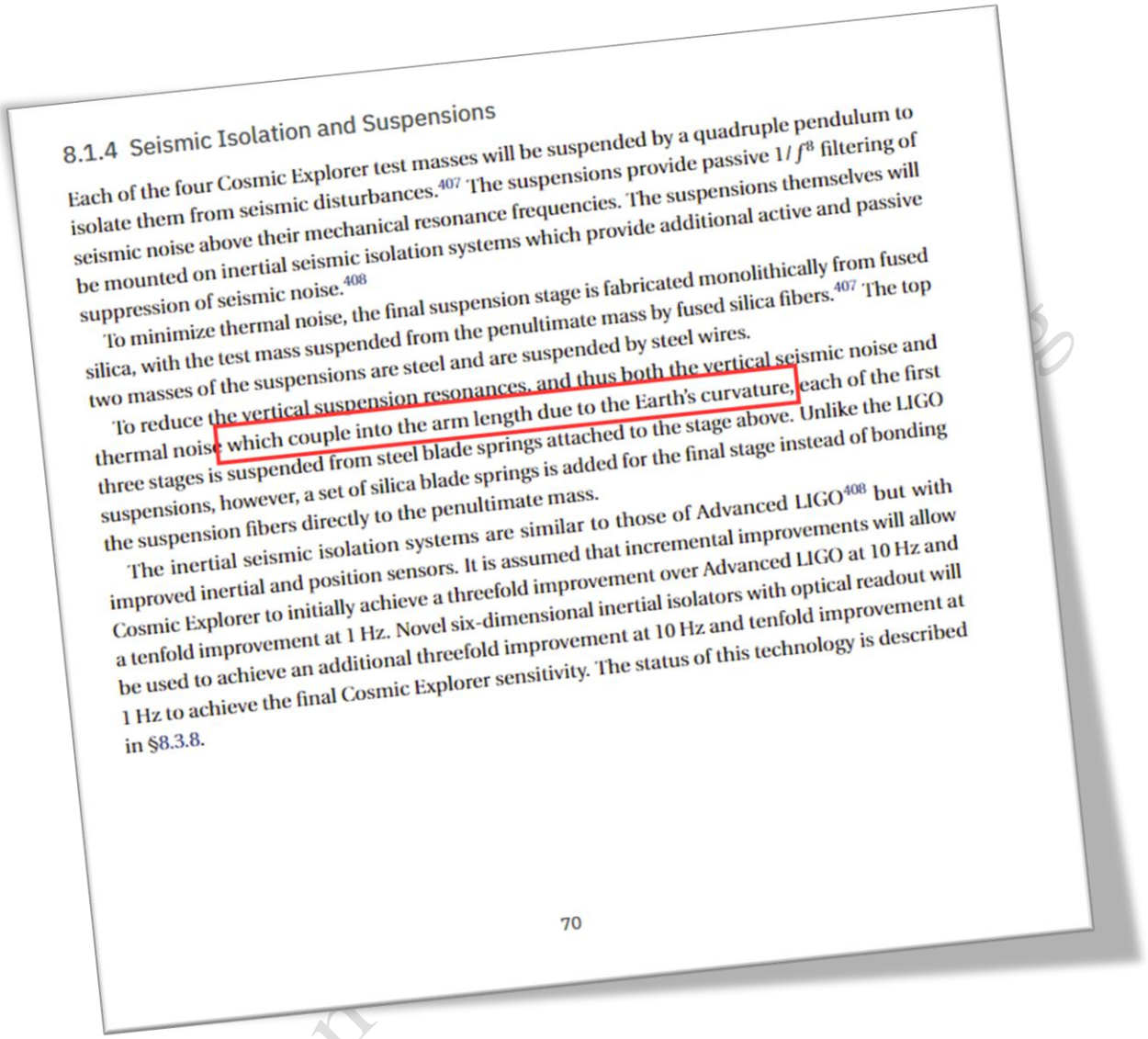
The Cosmic Explorer interferometer is a third-generation gravitational wave detector project currently under study by several European institutions. This telescope will be capable of testing Einstein's theory of general relativity under strong field conditions and performing high-precision gravitational wave astronomy.

Its construction has not yet been scheduled at the day we write these lines, but it seems certain that the arms of the interferometer will be **40 kilometers long**!

Figure 140 Artist's rendering of the future Cosmic Explorer interferometer

As indicated in three reports from the Cosmic Explorer project committee, the construction of the spacecraft requires taking into account the curvature of the Earth. On the project's official website itself (!), we find:

https://dcc.cosmicexplorer.org/public/0163/P2100003/007/ce-horizon-study.pdf



8.1.4 Seismic Isolation and Suspensions

Each of the four Cosmic Explorer test masses will be suspended by a quadruple pendulum to isolate them from seismic disturbances.[407] The suspensions provide passive $1/f^8$ filtering of seismic noise above their mechanical resonance frequencies. The suspensions themselves will be mounted on inertial seismic isolation systems which provide additional active and passive suppression of seismic noise.[408]

To minimize thermal noise, the final suspension stage is fabricated monolithically from fused silica, with the test mass suspended from the penultimate mass by fused silica fibers.[407] The top two masses of the suspensions are steel and are suspended by steel wires.

To reduce the vertical suspension resonances, and thus both the vertical seismic noise and thermal noise which couple into the arm length due to the Earth's curvature, each of the first three stages is suspended from steel blade springs attached to the stage above. Unlike the LIGO suspensions, however, a set of silica blade springs is added for the final stage instead of bonding the suspension fibers directly to the penultimate mass.

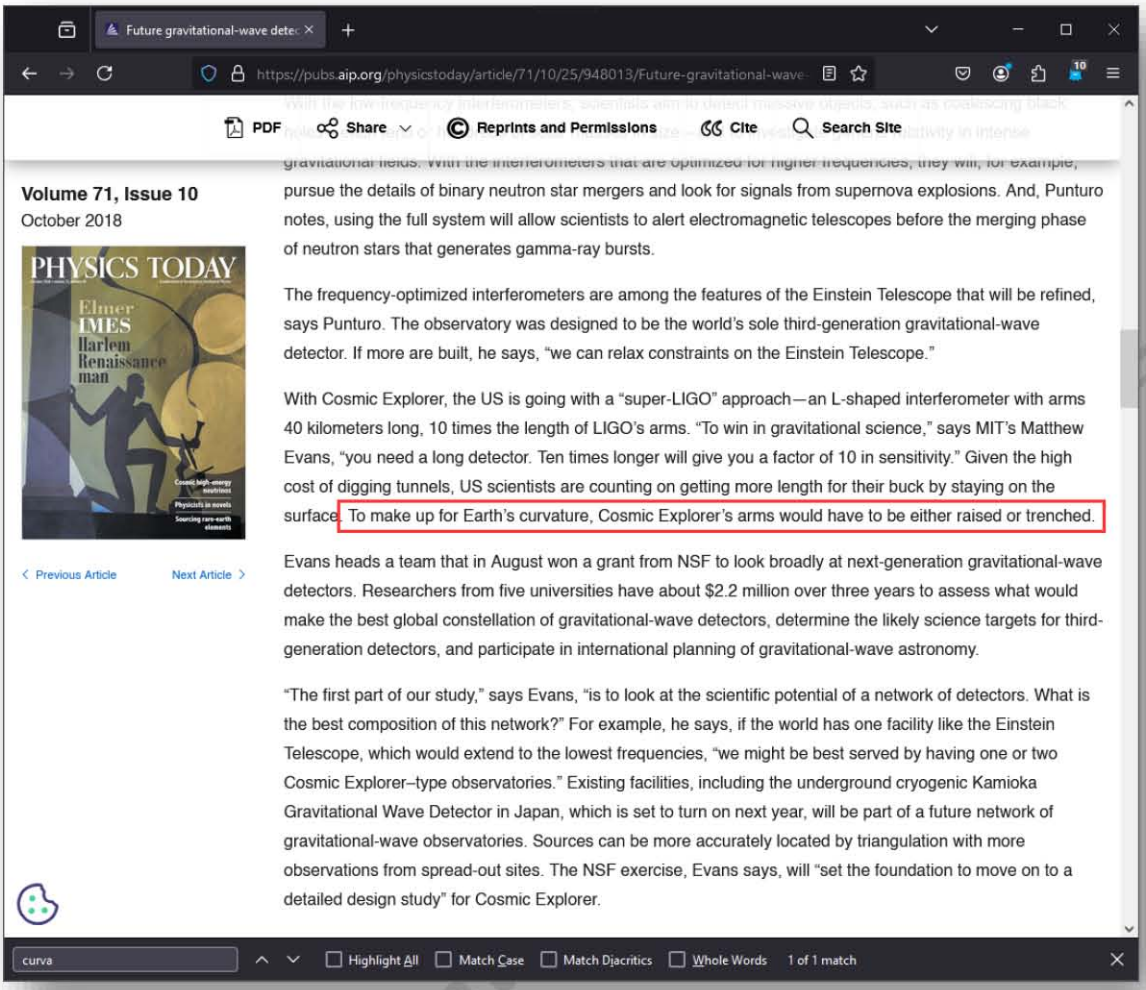
The inertial seismic isolation systems are similar to those of Advanced LIGO[408] but with improved inertial and position sensors. It is assumed that incremental improvements will allow Cosmic Explorer to initially achieve a threefold improvement over Advanced LIGO at 10 Hz and a tenfold improvement at 1 Hz. Novel six-dimensional inertial isolators with optical readout will be used to achieve an additional threefold improvement at 10 Hz and tenfold improvement at 1 Hz to achieve the final Cosmic Explorer sensitivity. The status of this technology is described in §8.3.8.

70

Or on another website:

https://pubs.aip.org/physicstoday/article/71/10/25/948013/Future-gravitational-wave-detectors-aim-to-probe

translation


Future gravitational-wave dete
https://pubs.aip.org/physicstoday/article/71/10/25/948013/Future-gravitational-wave
PDF
Share
Reprints and Permissions
Cite
Search Site
Volume 71, Issue 10
October 2018
PHYSICS TODAY
Elmer IMES
Harlem Renaissance man
Previous Article
Next Article
pursue the details of binary neutron star mergers and look for signals from supernova explosions. And, Punturo notes, using the full system will allow scientists to alert electromagnetic telescopes before the merging phase of neutron stars that generates gamma-ray bursts.
The frequency-optimized interferometers are among the features of the Einstein Telescope that will be refined, says Punturo. The observatory was designed to be the world's sole third-generation gravitational-wave detector. If more are built, he says, "we can relax constraints on the Einstein Telescope."
With Cosmic Explorer, the US is going with a "super-LIGO" approach—an L-shaped interferometer with arms 40 kilometers long, 10 times the length of LIGO's arms. "To win in gravitational science," says MIT's Matthew Evans, "you need a long detector. Ten times longer will give you a factor of 10 in sensitivity." Given the high cost of digging tunnels, US scientists are counting on getting more length for their buck by staying on the surface. To make up for Earth's curvature, Cosmic Explorer's arms would have to be either raised or trenched.
Evans heads a team that in August won a grant from NSF to look broadly at next-generation gravitational-wave detectors. Researchers from five universities have about $2.2 million over three years to assess what would make the best global constellation of gravitational-wave detectors, determine the likely science targets for third-generation detectors, and participate in international planning of gravitational-wave astronomy.
"The first part of our study," says Evans, "is to look at the scientific potential of a network of detectors. What is the best composition of this network?" For example, he says, if the world has one facility like the Einstein Telescope, which would extend to the lowest frequencies, "we might be best served by having one or two Cosmic Explorer–type observatories." Existing facilities, including the underground cryogenic Kamioka Gravitational Wave Detector in Japan, which is set to turn on next year, will be part of a future network of gravitational-wave observatories. Sources can be more accurately located by triangulation with more observations from spread-out sites. The NSF exercise, Evans says, will "set the foundation to move on to a detailed design study" for Cosmic Explorer.
curva
Highlight All
Match Case
Match Diacritics
Whole Words
1 of 1 match

translation in

(#253) Gravitational wave time-distance

As proven in General Relativity, gravitational waves travel at the speed of light (Opera Magistris, 2024):

$$\frac{\partial^2 h_{\mu\nu}}{\partial x^2} + \frac{\partial^2 h_{\mu\nu}}{\partial y^2} + \frac{\partial^2 h_{\mu\nu}}{\partial z^2} = \frac{1}{c^2}\frac{\partial^2 h_{\mu\nu}}{\partial t^2}$$

The illustration below shows a simplified, 2D naive version of the merger of two Black Holes and the gravitational waves propagating outwards as the black holes spiral towards each other. The Black Holes, which represent those detected by LIGO on December 26, 2015, were respectively 14 and 8 times the mass of the Sun, until their merger, forming a single Black Hole 21 times the mass of the Sun. In reality, the area near the black holes would appear highly distorted, and the gravitational waves would be difficult to see directly.

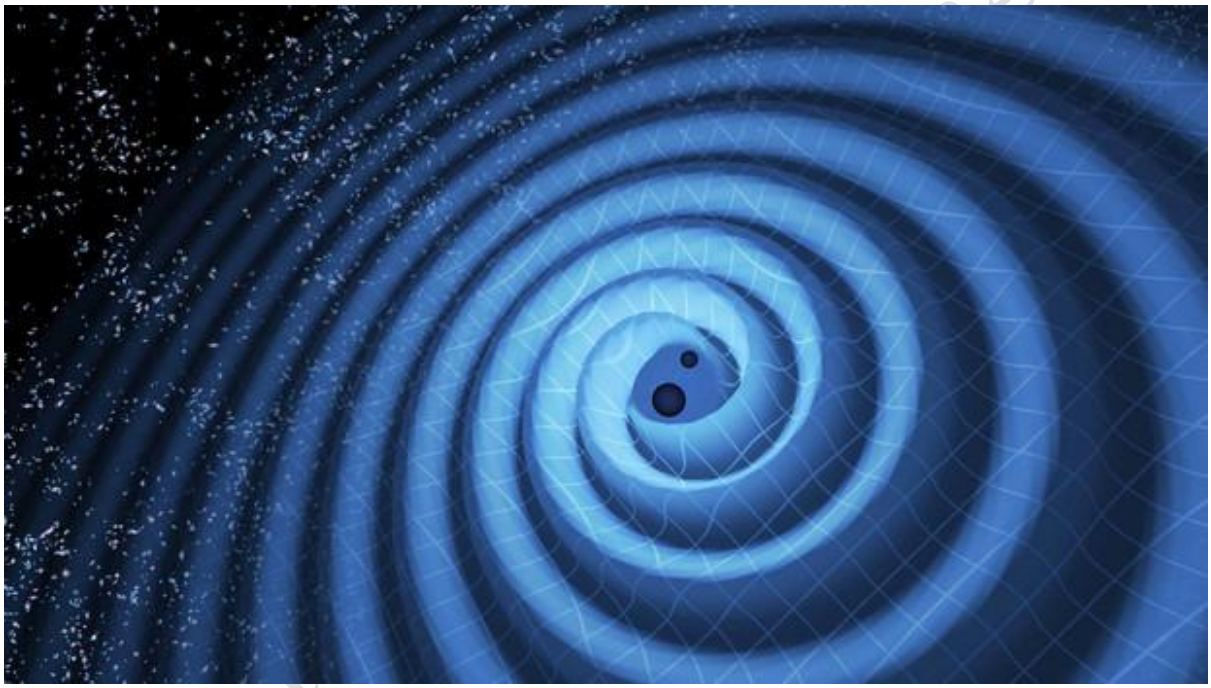


Figure 141 Simplified artist's illustration of the merging of two Black Holes (source: LIGO/T. Pyle)

Since gravitational waves are not slowed down by the presence of matter and always travel at the speed of light, it is easy to verify the detection time-distance between LIGO detectors, and these detectors are compatible with the distances of a spherical Earth and not a flat Earth:

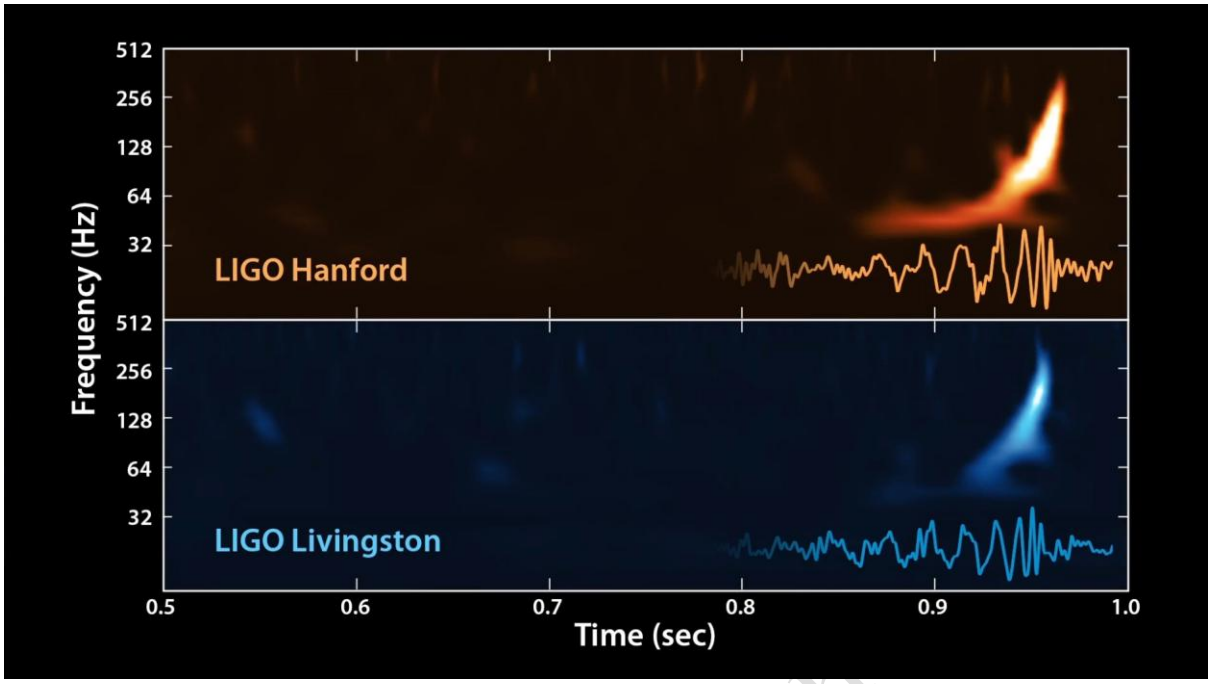


Figure 142 As black holes spiral closer together, the frequency of their gravitational waves increases. (image credit: LIGO, February 11, 2016)

The limited speed of a gravitational wave induces a detection delay (up to about 10 milliseconds) between the two LIGO detectors (Bounding the Speed of Gravity with Gravitational Wave Observations, 2017).

translation into english

Particle accelerators

(#254) SPS CERN (Geneva/Switzerland)

The Super Proton Synchrotron (SPS) accelerator is a synchrotron-type particle accelerator located at CERN, near Geneva, Switzerland. It is housed in a circular tunnel with a circumference of 6.9 kilometers.

The SPS was commissioned in 1976 and has played a crucial role in several major discoveries in particle physics. For example, it was used to discover the W and Z bosons, which earned Carlo Rubbia and Simon van der Meer a Nobel Prize in 1984.

Today, the SPS primarily serves as an injector for the Large Hadron Collider (LHC), accelerating protons from 26 GeV to 450 GeV before they are further accelerated by the LHC. It also continues to be used for fixed-target experiments and as a testbed for new concepts in accelerator physics.

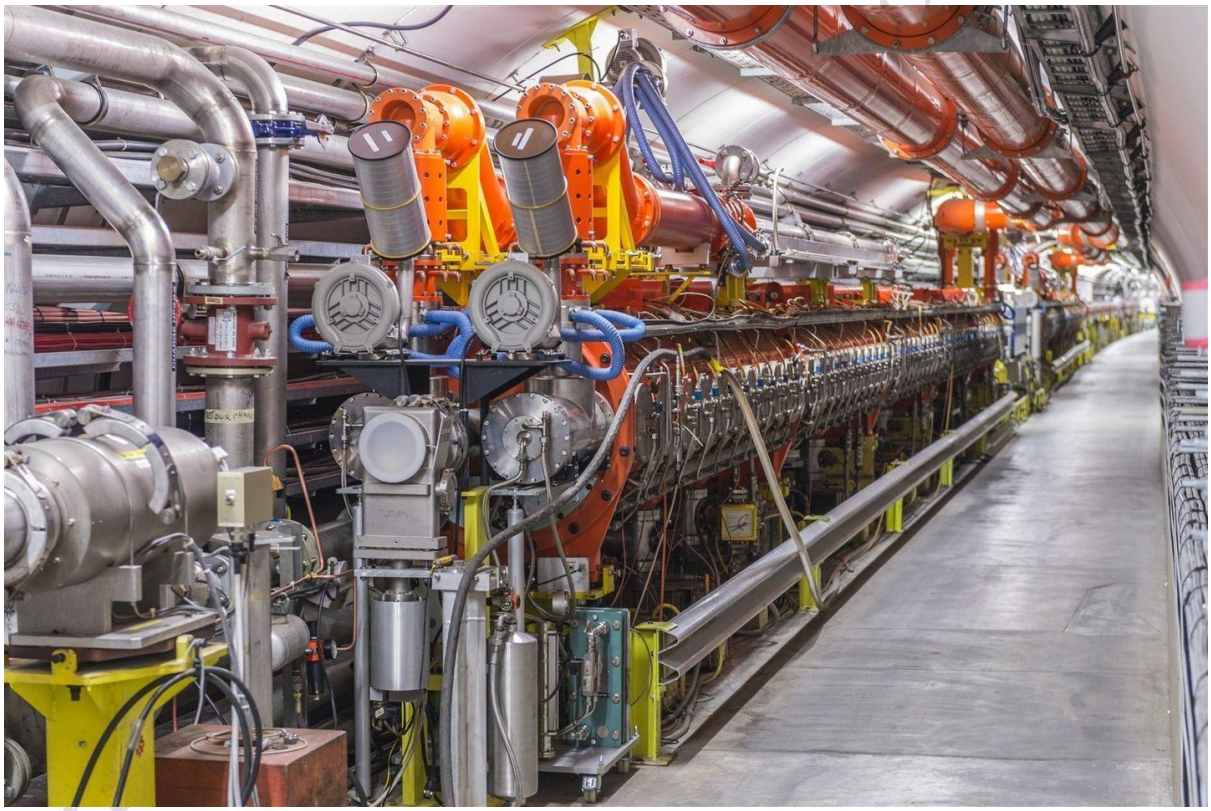


Figure 143 Photo of part of the SPS tunnel (source: CERN)

On the CERN file server, at the address:

https://cds.cern.ch/record/118941/files/CM-P00060848.pdf

We can found the following document that is explicit enough about the topic of Earth's curvature:

But before explaining how the geodetic work is done, it should be mentioned that the geodetic approach requires computations to allow for the curvature of the earth. The distances measured had to be reduced to sea level and it was even necessary to create a local projection system. The curvature of the earth posed unexpected problems in the leveling operations. If a plane cuts through a sphere the result is a circle. The orbit of the synchrotron is not a circular one but consists of six circular sextants having a radius of 947 m, separated by six 250 m-straight insertions. In these long straight sections the deviation from the mean plane of the ring, which has a radius of 947 m, is 2.3 mm, which is by no means negligible. Furthermore, as the ISR and SPS are constructed horizontally to within a few tenths of a millimetre, the planes of these machines are not parallel to that of the 28 GeV synchrotron; the angles their normals form with that of the PS are 0.09 mrad and 0.23 mrad respectively (Figure 11).

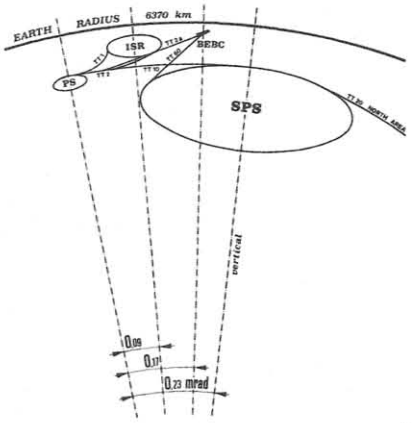


Figure 11 : Influence of the earth's curvature

translation into english

(#255) LHC (Geneva/Switzerland)

The Large Hadron Collider (LHC) is the largest and most powerful particle accelerator in the world. Located at CERN, near Geneva, it consists of a 27 kilometers circumference ring filled with thousands of powerful superconducting magnets.

The LHC was designed to allow physicists to test the predictions of various theories of particle physics. It accelerates beams of protons and heavy ions to speeds close to that of light before causing them to collide. These collisions allow scientists to explore the fundamental properties of matter.

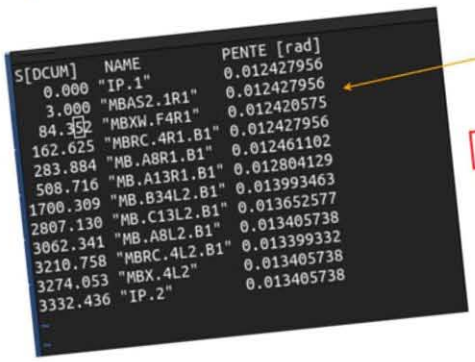
Figure 144 Photo of the LHC tunnel (source: CERN)

On the CERN file server, at the address:

https://indico.cern.ch/event/1416715/contributions/5954611/attachments/2856989/4997423/Slope%20in%20LHC%20(2).pdf

We have a PowerPoint presentation from an internal meeting that clearly demonstrates a particular data processing technique that highlights the curvature of the Earth:

Slope in LHC



S[DCUM]	NAME	PENTE [rad]
0.000	"IP.1"	0.012427956
3.000	"MBAS2.1R1"	0.012427956
84.3[illegible]52	"MBXW.F4R1"	0.012420575
162.625	"MBRC.4R1.B1"	0.012427956
283.884	"MB.A8R1.B1"	0.012461102
508.716	"MB.A13R1.B1"	0.012804129
1700.309	"MB.B34L2.B1"	0.013993463
2807.130	"MB.C13L2.B1"	0.013652577
3062.341	"MB.A8L2.B1"	0.013405738
3210.758	"MBRC.4L2.B1"	0.013399332
3274.053	"MBX.4L2"	0.013405738
3332.436	"IP.2"	0.013405738

Slope with respect to P0 (centre of PS)

Due to earth curvature the local vertical is different from the vertical in P0.

The errors is about:

1km/40075km 2π = 0.000157 rad/km

For the LHC would be about: 0.00157 rad.

translation into english

(#256) Stanford's SLAC (United States)

The SLAC National Accelerator Laboratory (formerly Stanford Linear Accelerator Center) is a research center located in Menlo Park, California, and administered by Stanford University on behalf of the U.S. Department of Energy. Founded in 1962, SLAC is known for its 3.2 kilometers-long linear accelerator, one of the longest in the world.

SLAC is at the forefront of research in particle physics, photonics, and materials science. Among its notable facilities is the Linac Coherent Light Source (LCLS), the world's first hard X-ray free-electron LASER. This LASER enables groundbreaking research in ultrafast science and high-energy physics.

The laboratory conducts research ranging from the study of subatomic particles to the exploration of material properties at the atomic scale. It also plays a key role in the development of new technologies for scientific and industrial applications.

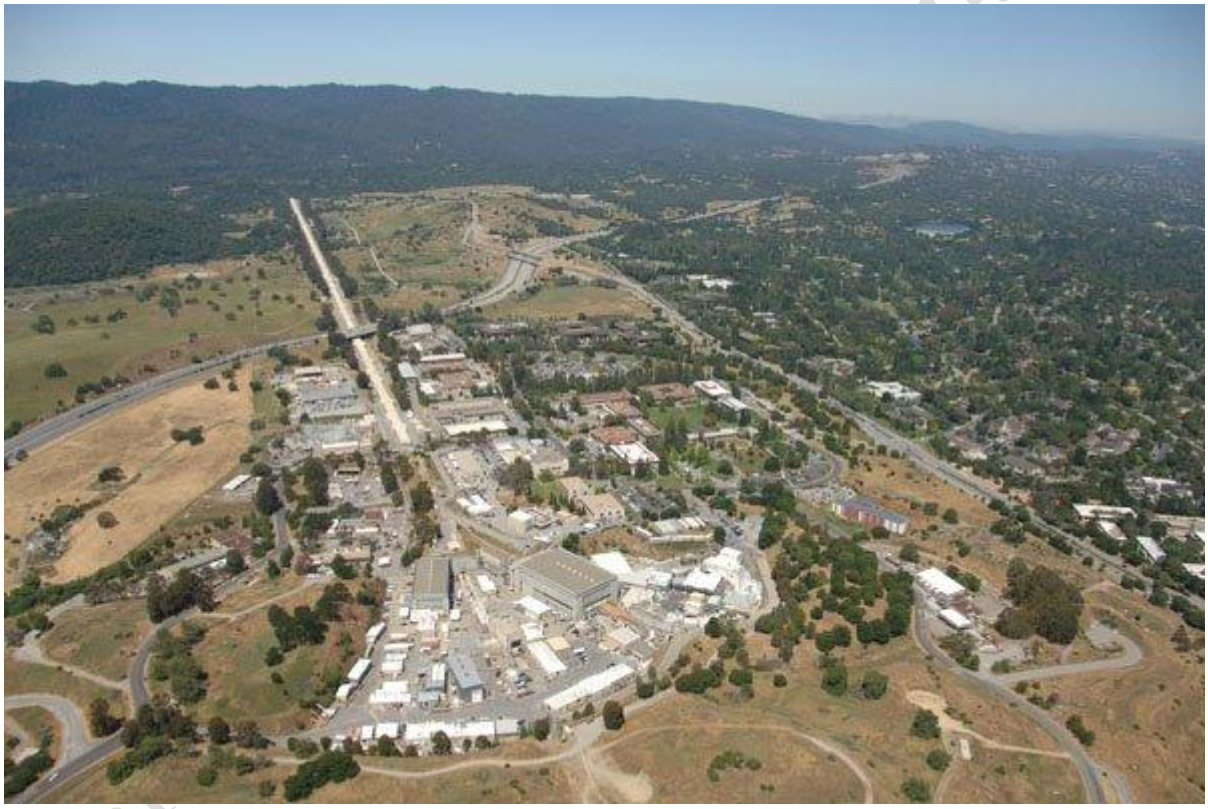
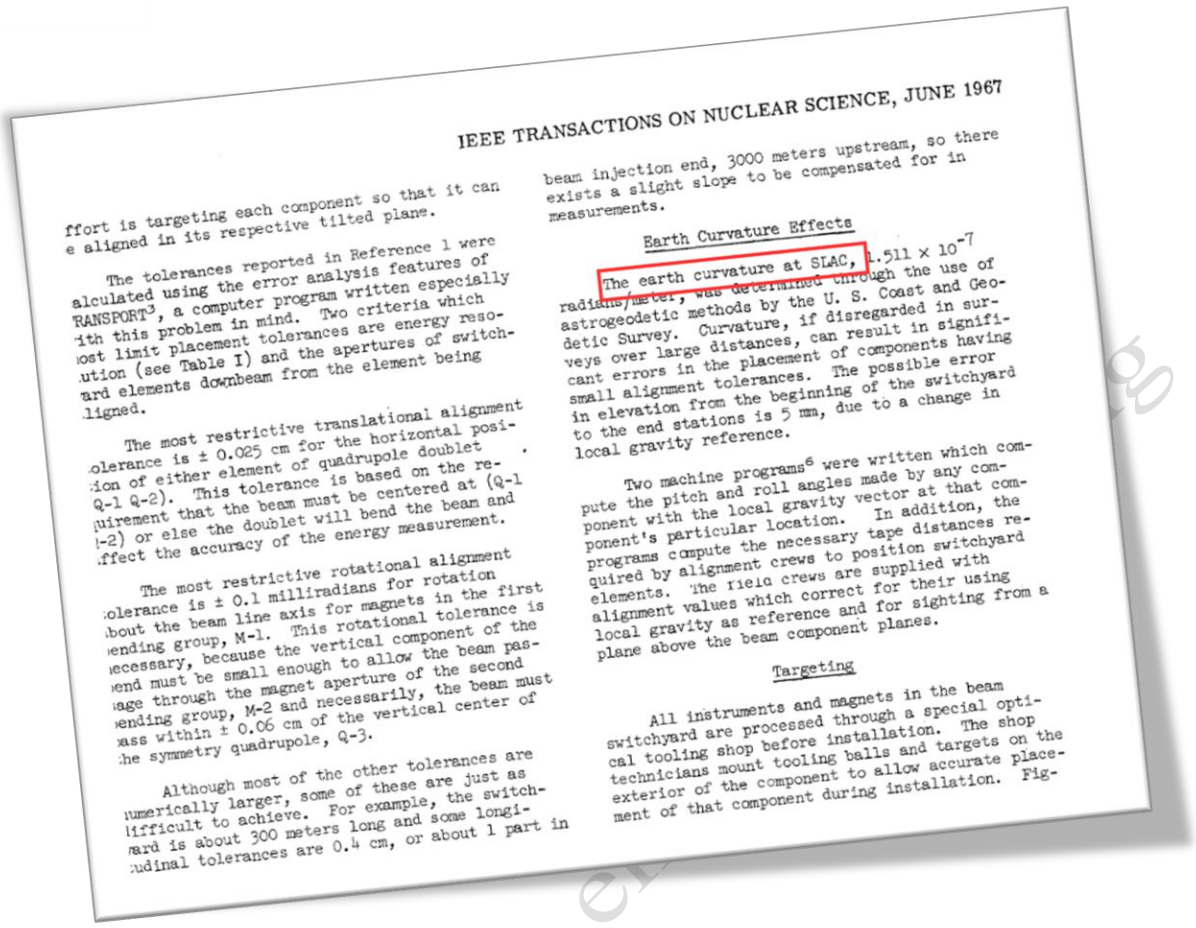


Figure 145 Aerial photo of the SLAC in Stanford, USA

On Stanford's SLAC file server itself, we find:

https://www.slac.stanford.edu/pubs/slacpubs/0250/slac-pub-0270.pdf



IEEE TRANSACTIONS ON NUCLEAR SCIENCE, JUNE 1967

ffort is targeting each component so that it can e aligned in its respective tilted plane.

The tolerances reported in Reference 1 were alculated using the error analysis features of RANSPORT[3], a computer program written especially ith this problem in mind. Two criteria which ost limit placement tolerances are energy reso- ution (see Table I) and the apertures of switch- ard elements downbeam from the element being ligned.

The most restrictive translational alignment olerance is ± 0.025 cm for the horizontal posi- ion of either element of quadrupole doublet Q-1 Q-2). This tolerance is based on the re- uirement that the beam must be centered at (Q-1 -2) or else the doublet will bend the beam and ffect the accuracy of the energy measurement.

The most restrictive rotational alignment olerance is ± 0.1 milliradians for rotation bout the beam line axis for magnets in the first ending group, M-1. This rotational tolerance is ecessary, because the vertical component of the end must be small enough to allow the beam pas- age through the magnet aperture of the second ending group, M-2 and necessarily, the beam must ass within ± 0.06 cm of the vertical center of he symmetry quadrupole, Q-3.

Although most of the other tolerances are umerically larger, some of these are just as ifficult to achieve. For example, the switch- ard is about 300 meters long and some longi- udinal tolerances are 0.4 cm, or about 1 part in beam injection end, 3000 meters upstream, so there exists a slight slope to be compensated for in measurements.

Earth Curvature Effects

The earth curvature at SLAC, 1.511 x 10^{-7} radians/meter, was determined through the use of astrogeodetic methods by the U. S. Coast and Geodetic Survey. Curvature, if disregarded in surveys over large distances, can result in significant errors in the placement of components having small alignment tolerances. The possible error in elevation from the beginning of the switchyard to the end stations is 5 mm, due to a change in local gravity reference.

Two machine programs[6] were written which compute the pitch and roll angles made by any component with the local gravity vector at that component's particular location. In addition, the programs compute the necessary tape distances required by alignment crews to position switchyard elements. The field crews are supplied with alignment values which correct for their using local gravity as reference and for sighting from a plane above the beam component planes.

Targeting

All instruments and magnets in the beam switchyard are processed through a special optical tooling shop before installation. The shop technicians mount tooling balls and targets on the exterior of the component to allow accurate placement of that component during installation. Fig-

translation into en

Which clearly mentions that the effect of the Earth's curvature had to be taken into account in the operation of the SLAC.

(#257) Tevatron Fermilab (Illinois/United States)

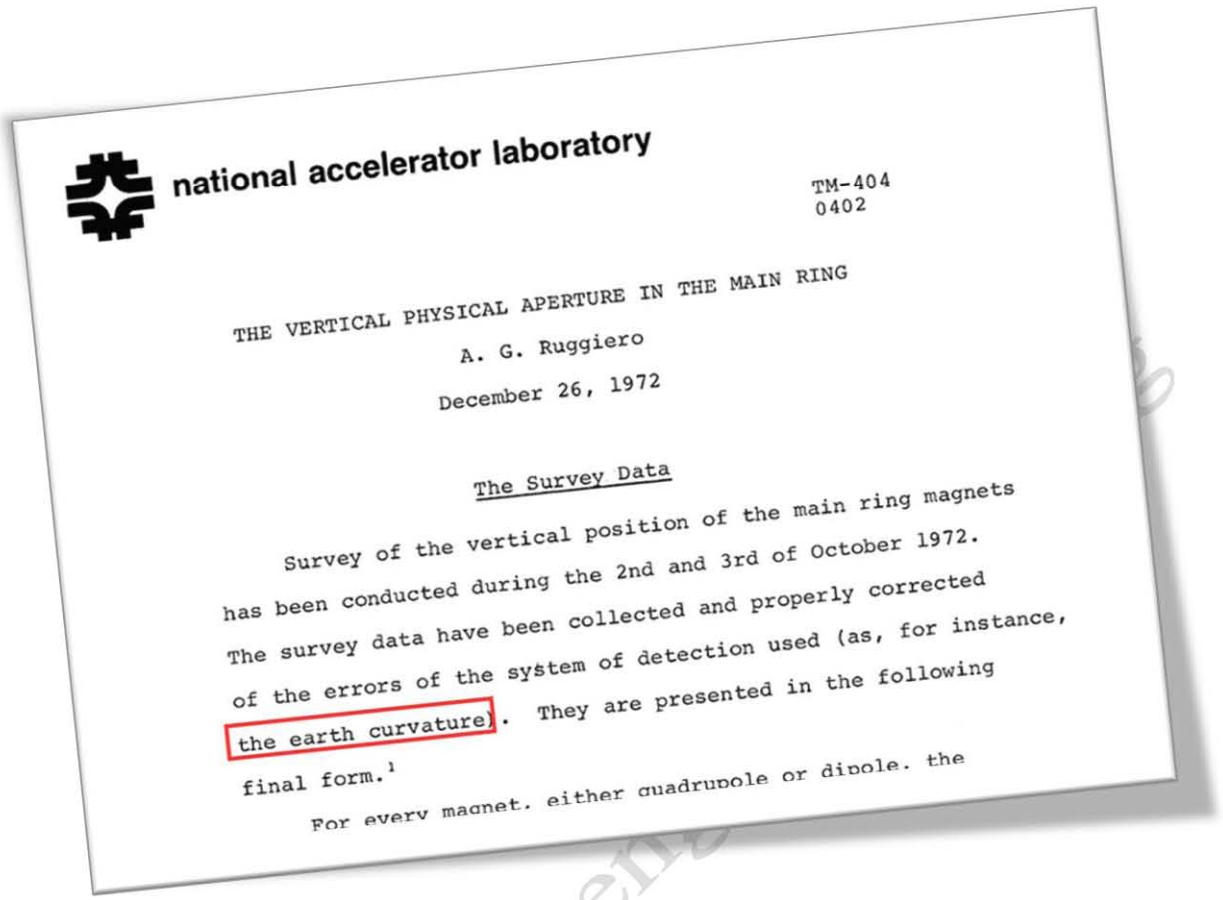
The Tevatron was a particle accelerator located at Fermilab, near Batavia, Illinois, in the United States. It was operational from 1983 until its closure in 2011. The Tevatron was a synchrotron capable of accelerating protons and antiprotons to energies of up to 1 TeV (teraelectronvolt), making it the most powerful particle collider in the world until the LHC at CERN became operational.

Among its most notable achievements, the Tevatron enabled the discovery of the top quark in 1995, one of the fundamental particles predicted by the Standard Model of Particle Physics. It also contributed to numerous technological advances in the fields of detectors, accelerators, and computing.

Although the Tevatron is now out of service, Fermilab continues to play a key role in particle physics research with other accelerators and experiments.

Among the many technical documents on the Fermilab website stating that the Earth's curvature is problematic and must be taken into account, we have, for example, on the Fermilab server itself:

https://lss.fnal.gov/archive/test-tm/0000/fermilab-tm-0404.pdf



national accelerator laboratory

TM-404
0402

THE VERTICAL PHYSICAL APERTURE IN THE MAIN RING

A. G. Ruggiero

December 26, 1972

The Survey Data

Survey of the vertical position of the main ring magnets has been conducted during the 2nd and 3rd of October 1972. The survey data have been collected and properly corrected of the errors of the system of detection used (as, for instance, the earth curvature). They are presented in the following final form.[1]

For every magnet, either quadrupole or dipole, the

translation into en

(#258) Ko Energy-kasokuki Kenkyukiko (KEK)

The High Energy Accelerator Research Organization (KEK)) is a research center located in Tsukuba, Japan. It is dedicated to high-energy physics and fundamental research in particle physics. KEK operates several particle accelerators, including SuperKEKB, a high-luminosity electron-positron collider.

SuperKEKB is an improved version of KEKB, which made it possible to experimentally verify the Kobayashi-Maskawa theory, awarded the Nobel Prize in Physics in 2008. In addition to SuperKEKB, KEK also operates the Photon Factory, a synchrotron light source used for research in materials science and biology.

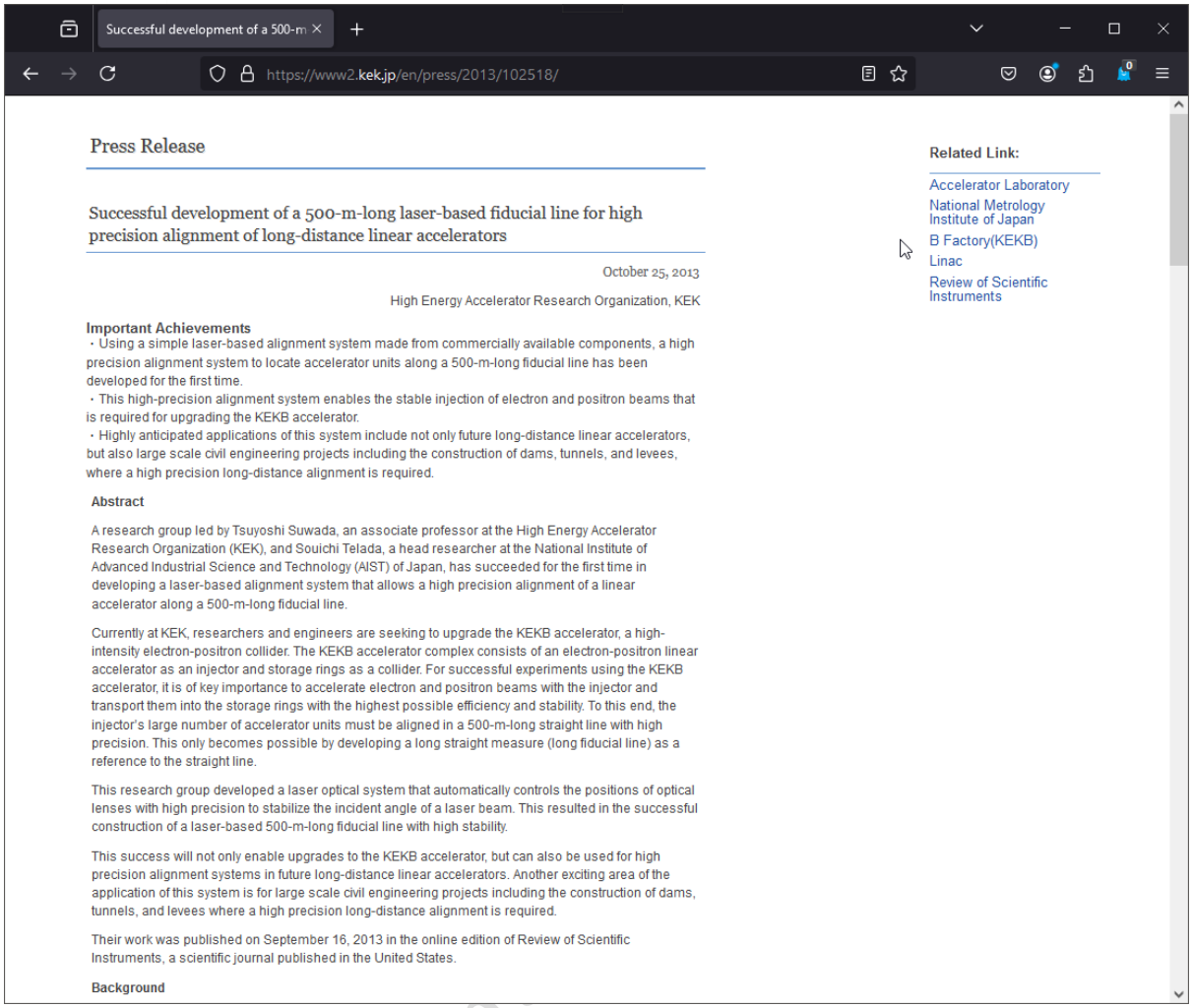
KEK collaborates with numerous laboratories and researchers around the world, and its facilities are used for experiments in particle physics, nuclear physics, as well as for industrial and medical applications.

Figure 146 KEK Japan Accelerator in Tsukuba, Japan

On the official KEK website hosted:

https://www2.kek.jp/en/press/2013/102518/

We can found the following document that is explicit enough about the topic of Earth's curvature:



Successful development of a 500-m

https://www2.kek.jp/en/press/2013/102518/

Press Release

Successful development of a 500-m-long laser-based fiducial line for high precision alignment of long-distance linear accelerators

October 25, 2013

High Energy Accelerator Research Organization, KEK

Important Achievements

・Using a simple laser-based alignment system made from commercially available components, a high precision alignment system to locate accelerator units along a 500-m-long fiducial line has been developed for the first time.
・This high-precision alignment system enables the stable injection of electron and positron beams that is required for upgrading the KEKB accelerator.
・Highly anticipated applications of this system include not only future long-distance linear accelerators, but also large scale civil engineering projects including the construction of dams, tunnels, and levees, where a high precision long-distance alignment is required.

Abstract

A research group led by Tsuyoshi Suwada, an associate professor at the High Energy Accelerator Research Organization (KEK), and Souichi Telada, a head researcher at the National Institute of Advanced Industrial Science and Technology (AIST) of Japan, has succeeded for the first time in developing a laser-based alignment system that allows a high precision alignment of a linear accelerator along a 500-m-long fiducial line.

Currently at KEK, researchers and engineers are seeking to upgrade the KEKB accelerator, a high-intensity electron-positron collider. The KEKB accelerator complex consists of an electron-positron linear accelerator as an injector and storage rings as a collider. For successful experiments using the KEKB accelerator, it is of key importance to accelerate electron and positron beams with the injector and transport them into the storage rings with the highest possible efficiency and stability. To this end, the injector's large number of accelerator units must be aligned in a 500-m-long straight line with high precision. This only becomes possible by developing a long straight measure (long fiducial line) as a reference to the straight line.

This research group developed a laser optical system that automatically controls the positions of optical lenses with high precision to stabilize the incident angle of a laser beam. This resulted in the successful construction of a laser-based 500-m-long fiducial line with high stability.

This success will not only enable upgrades to the KEKB accelerator, but can also be used for high precision alignment systems in future long-distance linear accelerators. Another exciting area of the application of this system is for large scale civil engineering projects including the construction of dams, tunnels, and levees where a high precision long-distance alignment is required.

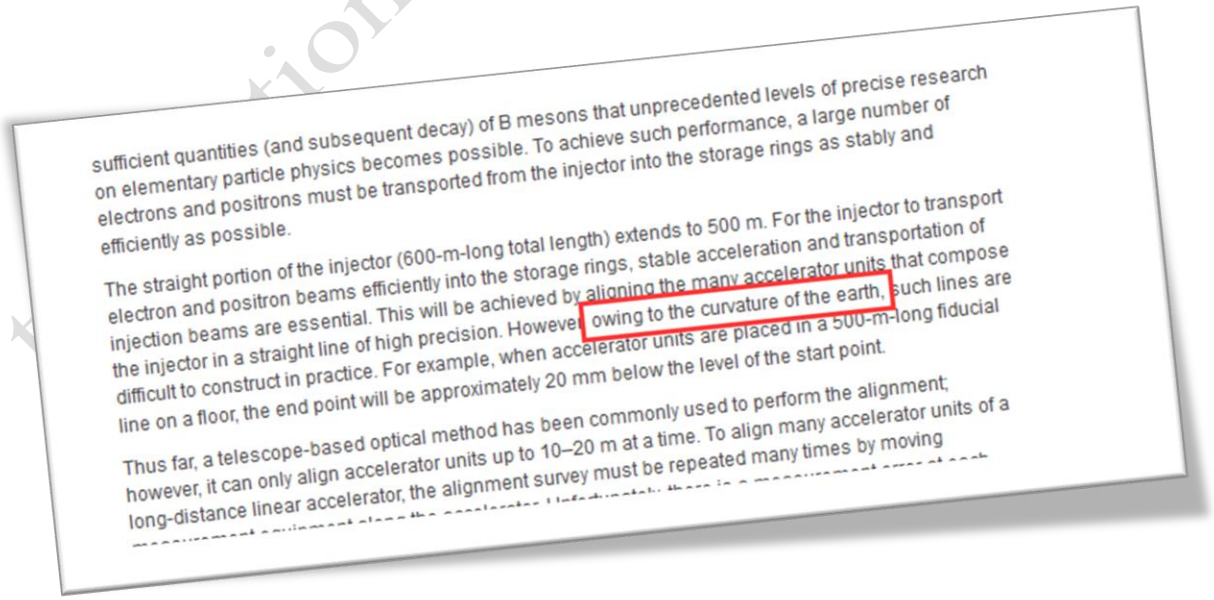
Their work was published on September 16, 2013 in the online edition of Review of Scientific Instruments, a scientific journal published in the United States.

Background

Related Link:

- Accelerator Laboratory
- National Metrology Institute of Japan
- B Factory(KEKB)
- Linac
- Review of Scientific Instruments

This provides confirmation that the Earth is indeed curved:



sufficient quantities (and subsequent decay) of B mesons that unprecedented levels of precise research on elementary particle physics becomes possible. To achieve such performance, a large number of electrons and positrons must be transported from the injector into the storage rings as stably and efficiently as possible.

The straight portion of the injector (600-m-long total length) extends to 500 m. For the injector to transport electron and positron beams efficiently into the storage rings, stable acceleration and transportation of injection beams are essential. This will be achieved by aligning the many accelerator units that compose the injector in a straight line of high precision. However, owing to the curvature of the earth, such lines are difficult to construct in practice. For example, when accelerator units are placed in a 500-m-long fiducial line on a floor, the end point will be approximately 20 mm below the level of the start point.

Thus far, a telescope-based optical method has been commonly used to perform the alignment; however, it can only align accelerator units up to 10–20 m at a time. To align many accelerator units of a long-distance linear accelerator, the alignment survey must be repeated many times by moving

(#259) Relativistic Heavy Ion Collider (RHIC)

The Relativistic Heavy Ion Collider (RHIC) is a particle accelerator located at Brookhaven National Laboratory (BNL) in Upton, New York. It is unique in the United States and one of only two heavy ion colliders in operation in the world.

The RHIC is designed to collide heavy ions, such as gold ions, at relativistic speeds—that is, close to the speed of light. These collisions allow physicists to study the primordial matter that existed just after the Big Bang. In 2010, experiments at the RHIC reached temperatures of over 4 trillion degrees Celsius, creating a state of matter called quark-gluon plasma.

The RHIC is also the only polarized proton collider, which allows exploration of the spin structure of protons1. In addition to its contributions to fundamental physics, the RHIC serves as a basis for the future Electron-Ion Collider (EIC), which will allow collisions between electrons and heavy ions for even more detailed studies.

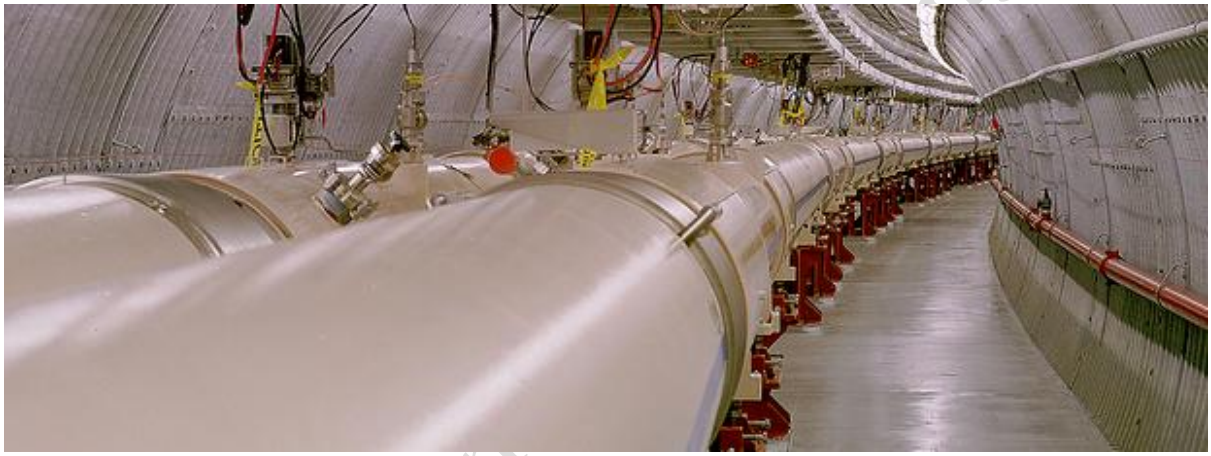


Figure 147 Photo from the Relativistic Heavy Ion Collider (RHIC)

In this document stored on the CERN file server here:

https://accelconf.web.cern.ch/p95/ARTICLES/TAA/TAA09.pdf

We have confirmation that the curvature of the Earth had to be taken into account:

translation in progress

II. The Global and Local Monument Networks in the RHIC Tunnel

The sixfold symmetry of the RHIC accelerators imposed the primary network of twelve survey monuments on the tunnel ¯oor[1]. A clear line of sight from the twelve platforms is available via a penetration through the tunnel berm. An additional tower is located at the geometrical center of RHIC. Clear lines of sight are available from this tower to each of the twelve peripheral instrument platforms. Two accelerators in the RHIC tunnel lie in a horizontal plane of an orthogonal Cartesian coordinate system where in the center of the rings the vertical axis points upward along the local gravity. The survey results of the primary network showed the error elipses for each of the twelve monuments to be between 0.32 mm and 0.70 mm on the major axis, and between 0.12 mm and 0.25 mm on the minor axis. The mean value on the major axis is 0.57 mm while the mean on the minor axis is 0.18 mm. The secondary network in the tunnel was established with the ¯oor monuments located at each half cell with a distance of 14.1 meters between them. Surveying in RHIC is performed by using a combination of PC compatible

* Work performed under the auspices of the U.S. Department of Energy

of the dipoles is determined by the rotating coil (³mole°) measurements with respect to the same gravitational plane. These measurements of the magnetic ®eld angle are performed at room temperature for all dipoles. The ®rst thirty dipoles, as well as every tenth dipole after that, are also measured at a superconducting temperature of 4.5 K with currents of 660 A, 1450 A, and 5000 A. A correlation between the cold and warm measurements of the ®eld angle shows a standard deviation of 0.20 mrad. The error in measurements as well as reproducibility, is also estimated to be ±0.2 mrad. The dipole ®eld angle obtained from the harmonic probe measurements is set to be perpendicular to the RHIC horizontal plane in the tunnel by a rotation around the axis which crosses the radius of the dipole curvature at 1/3 of the average sagitta. The RHIC horizontal Cartesian plane perpendicular to the center gravitational vector is obtained after correction to the earth ellipsoidal curvature [1].

A. Production Control of CQS Assemblies

The three elements of the CQS assemblies are connected together inside the two welded ³cold-mass° shells. The corrector, quadrupole, and sextupole vertical and radial positions are measured by the dial gauge indicator with electronic data transfer [5]. The quadrupole mechanical center is estimated from the measurements of the four upper and four lower notches in the

translation into englis

(#260) SwissFel (free electron LASER)

SwissFEL (Swiss X-ray Free Electron LASER) is the X-ray free electron LASER of the Paul Scherrer Institute (PSI), inaugurated in December 2016.

The SwissFEL design is optimized to generate X-ray pulses in the wavelength range of 1 Å to 70 Å. With a total length of just under 740 meters, the system configuration is relatively compact. Construction of the SwissFEL began in spring 2013. Once the building was completed, the installation of the technical components began in early 2015. The first pilot experiments were conducted in 2017. In 2018, the first beamline, named ARAMIS, was commissioned. The second beamline, ATHOS, was inaugurated in june 2020.

ARAMIS produces very high-energy shortwave X-rays, which can be used to monitor the behavior of atoms during rapid processes. ATHOS produces softer, lower-energy X-rays, enabling the observation of atoms and molecules as they form new chemical bonds. The total construction cost is approximately 275 million Swiss francs.

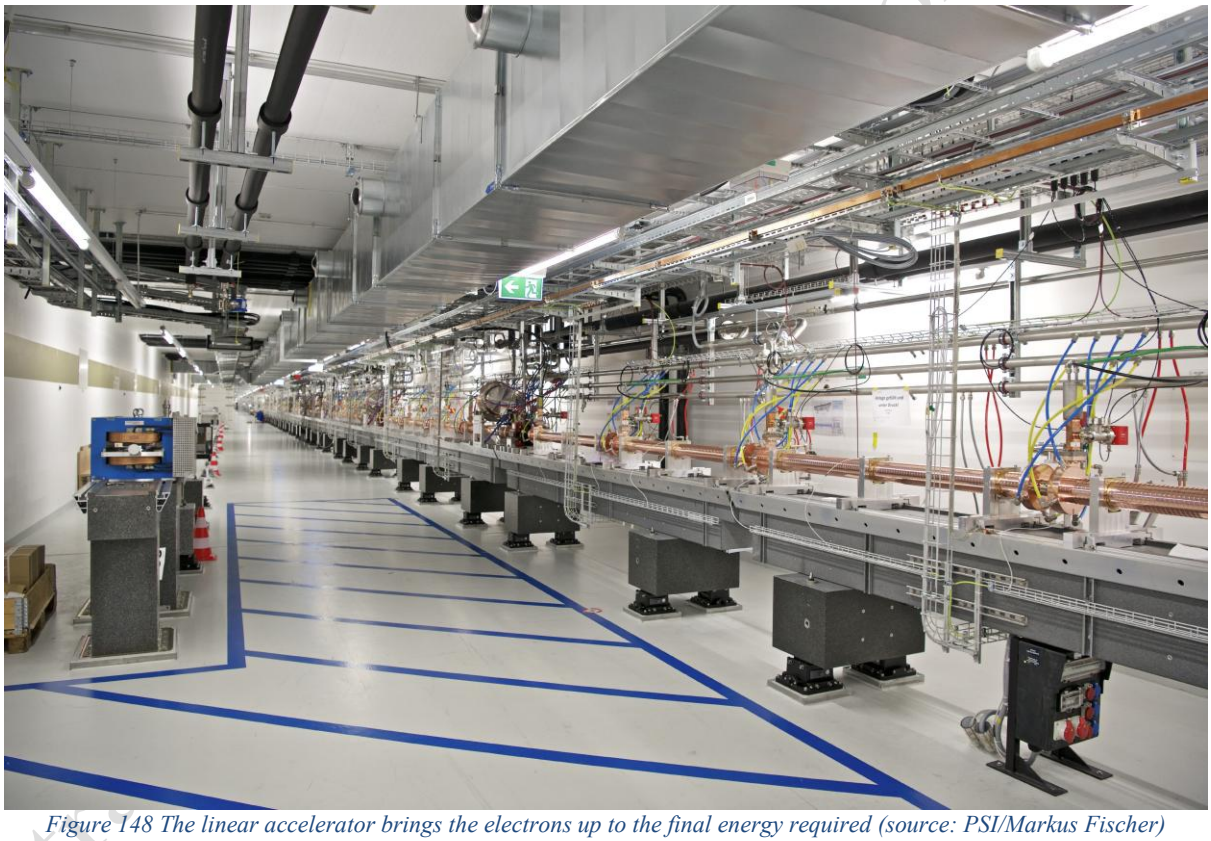
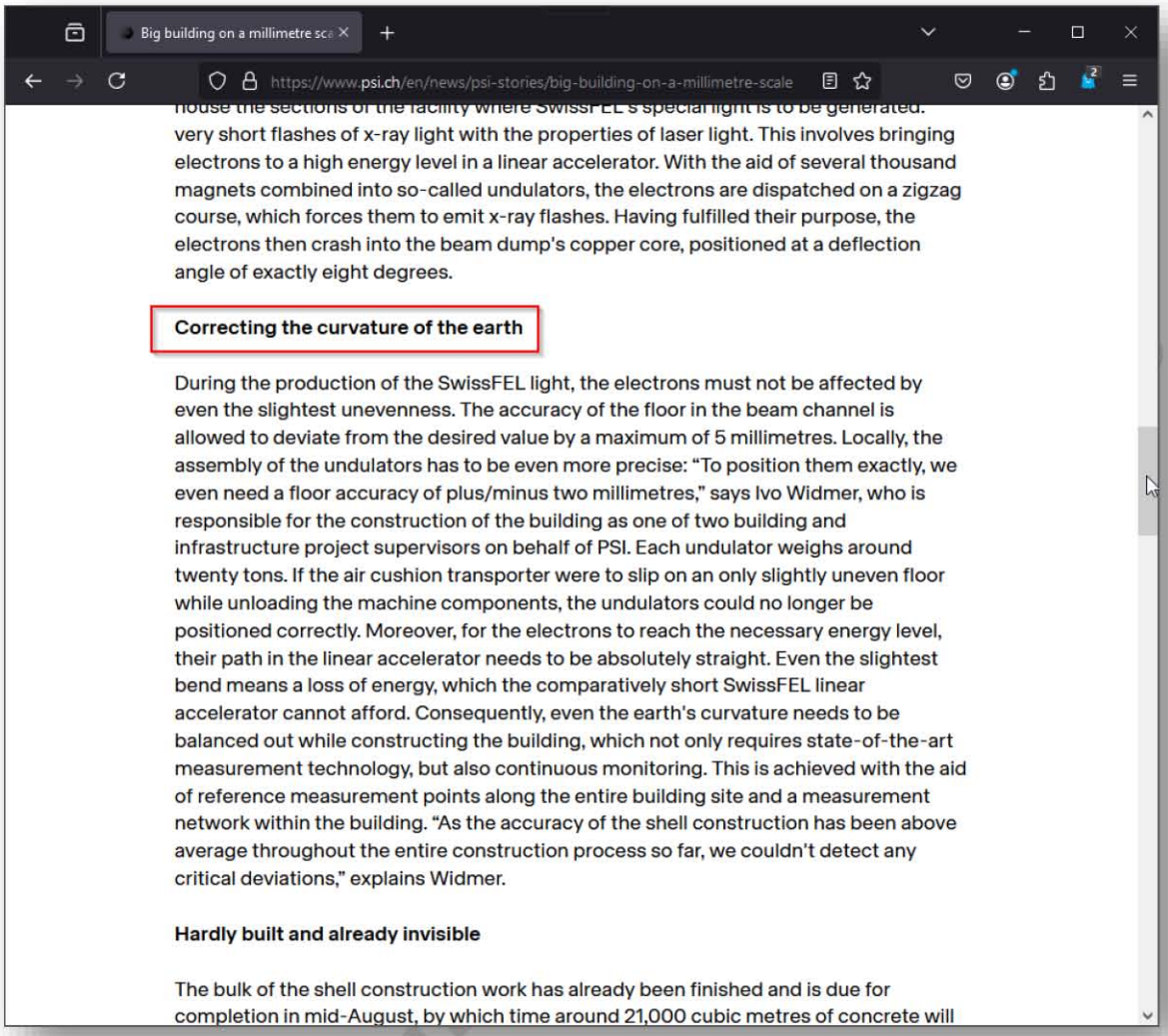


Figure 148 The linear accelerator brings the electrons up to the final energy required (source: PSI/Markus Fischer)

As announced on the institute's official website:

https://www.psi.ch/en/news/psi-stories/big-building-on-a-millimetre-scale

The curvature of the Earth had to be taken into account during the construction work:

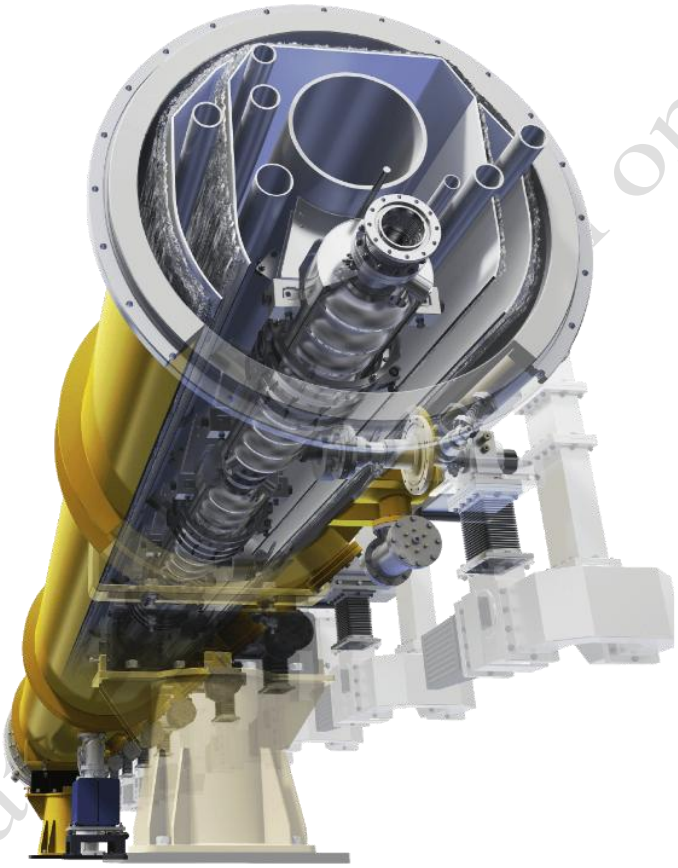

Big building on a millimetre sca
https://www.psi.ch/en/news/psi-stories/big-building-on-a-millimetre-scale
house the sections of the facility where SwissFEL's special light is to be generated.
very short flashes of x-ray light with the properties of laser light. This involves bringing electrons to a high energy level in a linear accelerator. With the aid of several thousand magnets combined into so-called undulators, the electrons are dispatched on a zigzag course, which forces them to emit x-ray flashes. Having fulfilled their purpose, the electrons then crash into the beam dump's copper core, positioned at a deflection angle of exactly eight degrees.
Correcting the curvature of the earth
During the production of the SwissFEL light, the electrons must not be affected by even the slightest unevenness. The accuracy of the floor in the beam channel is allowed to deviate from the desired value by a maximum of 5 millimetres. Locally, the assembly of the undulators has to be even more precise: "To position them exactly, we even need a floor accuracy of plus/minus two millimetres," says Ivo Widmer, who is responsible for the construction of the building as one of two building and infrastructure project supervisors on behalf of PSI. Each undulator weighs around twenty tons. If the air cushion transporter were to slip on an only slightly uneven floor while unloading the machine components, the undulators could no longer be positioned correctly. Moreover, for the electrons to reach the necessary energy level, their path in the linear accelerator needs to be absolutely straight. Even the slightest bend means a loss of energy, which the comparatively short SwissFEL linear accelerator cannot afford. Consequently, even the earth's curvature needs to be balanced out while constructing the building, which not only requires state-of-the-art measurement technology, but also continuous monitoring. This is achieved with the aid of reference measurement points along the entire building site and a measurement network within the building. "As the accuracy of the shell construction has been above average throughout the entire construction process so far, we couldn't detect any critical deviations," explains Widmer.
Hardly built and already invisible
The bulk of the shell construction work has already been finished and is due for completion in mid-August, by which time around 21,000 cubic metres of concrete will

translation

(#261) International Linear Collider (project)

The International Linear Collider (ILC) will be an indispensable tool for unlocking some of the deepest mysteries of the universe. The ILC will allow physicists to precisely explore regions at very high energies.

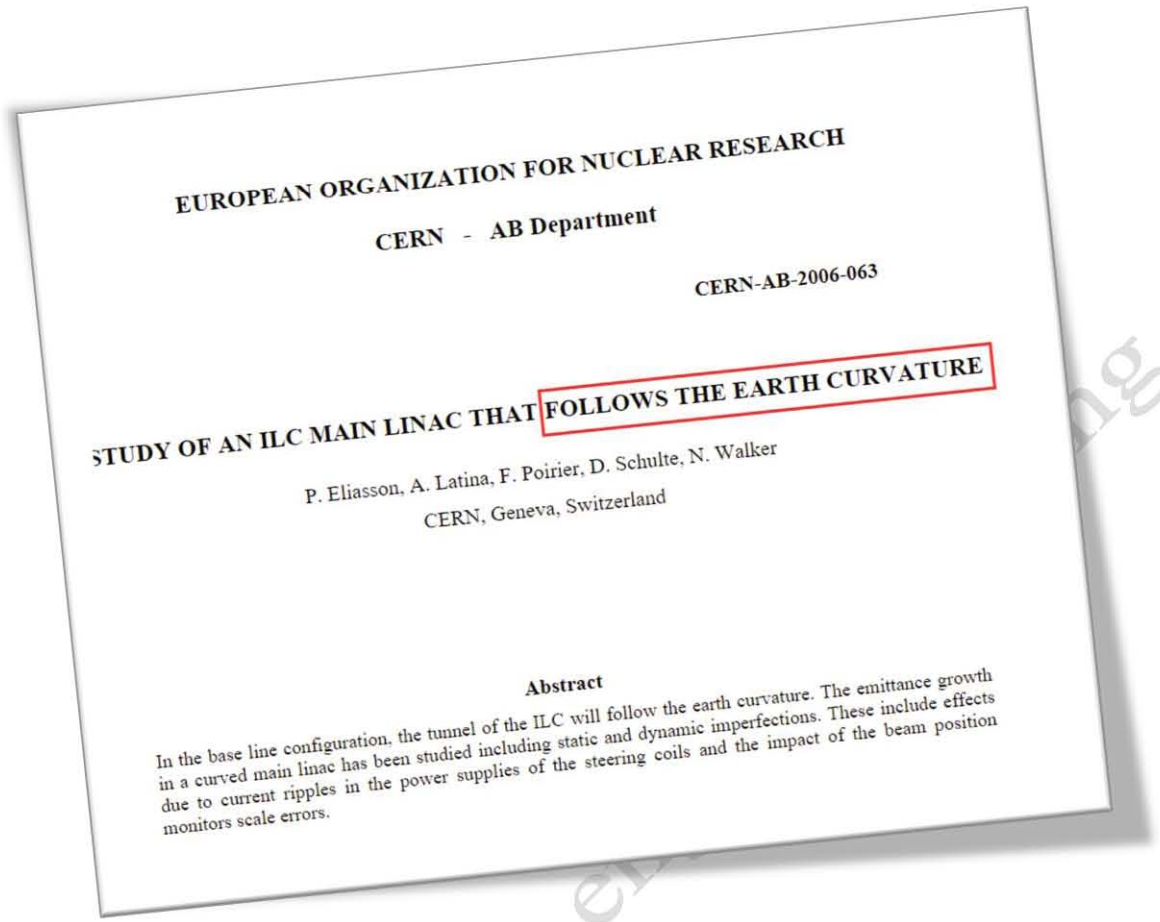
Composed of two linear accelerators stretching approximately 20 kilometers, the ILC will collide electrons and their antimatter counterparts, positrons, at near-light speeds. By colliding nearly 7,000 times per second, the electrons and positrons will create a set of new particles that could help answer some of the most fundamental questions of all time like: What is the Higgs boson? What are dark matter and dark energy? Does supersymmetry exist?



In this document stored on the CERN file server here:

https://cds.cern.ch/record/972421/files/ab-2006-063.pdf

We can found the following document that is explicit enough about the topic of Earth's curvature:



EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

CERN - AB Department

CERN-AB-2006-063

STUDY OF AN ILC MAIN LINAC THAT FOLLOWS THE EARTH CURVATURE

P. Eliasson, A. Latina, F. Poirier, D. Schulte, N. Walker

CERN, Geneva, Switzerland

Abstract

In the base line configuration, the tunnel of the ILC will follow the earth curvature. The emittance growth in a curved main linac has been studied including static and dynamic imperfections. These include effects due to current ripples in the power supplies of the steering coils and the impact of the beam position monitors scale errors.

translation into en ng

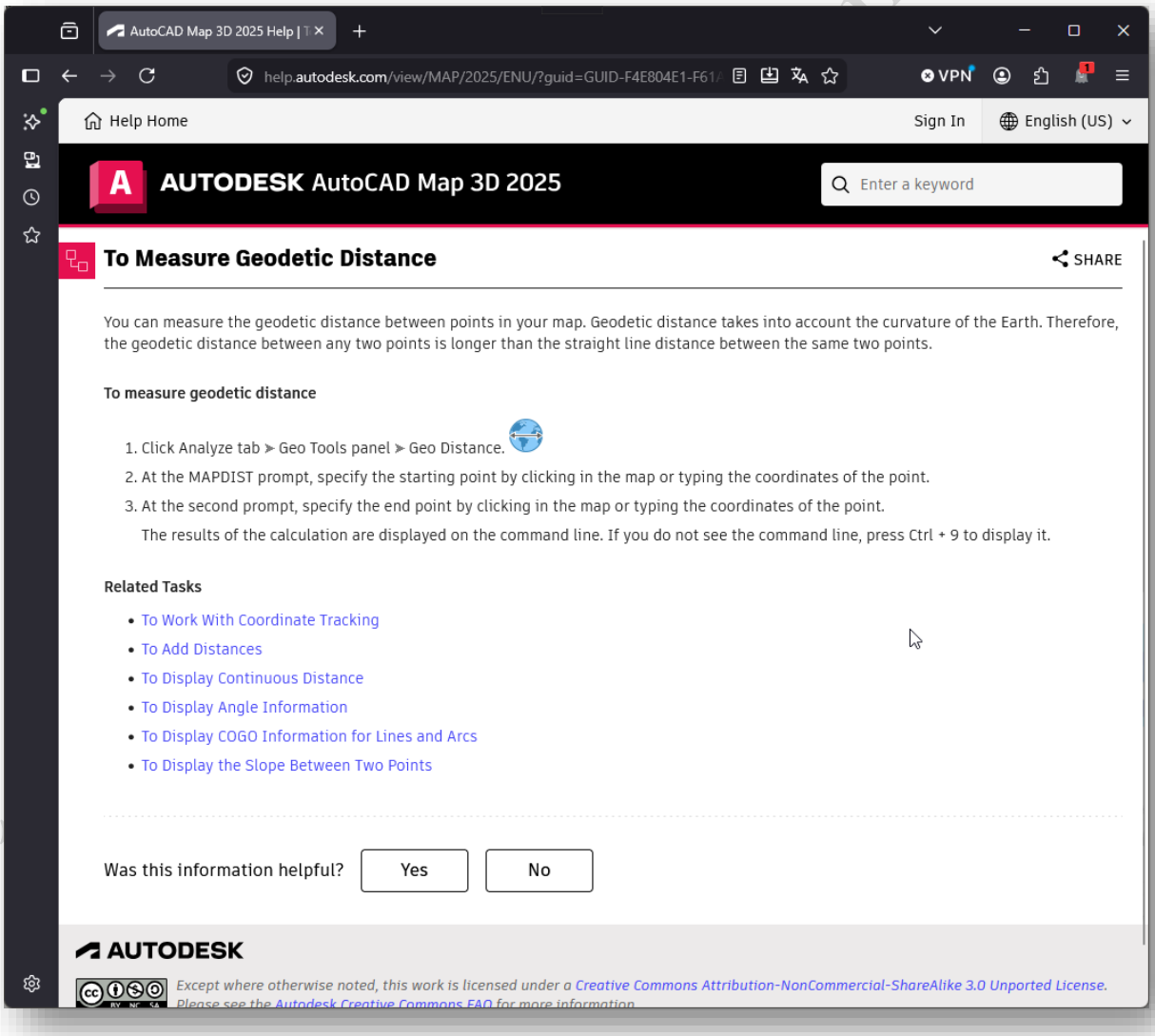
Softwares

(#262) AUTODESK AutoCAD Map 3D software measures curvature

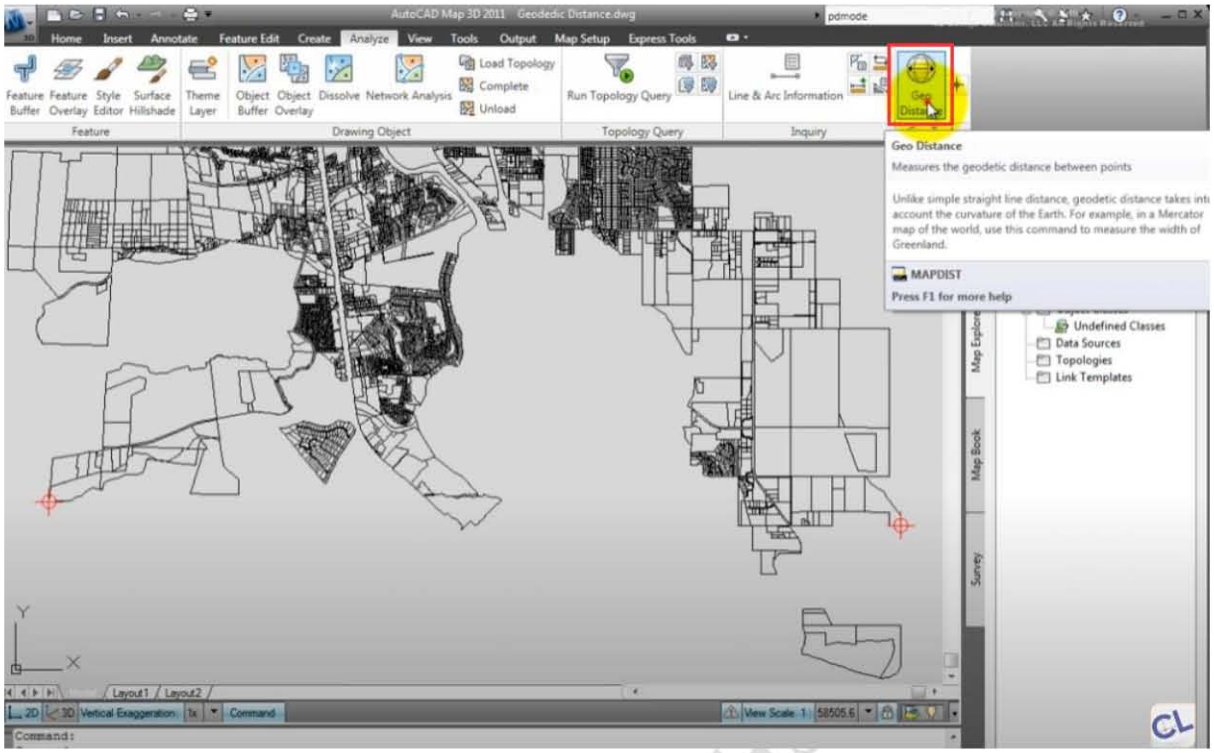
Autodesk's AutoCAD is known as the most widely used software in the world for architectural, civil engineering, and mechanical engineering projects. It would therefore seem logical that if the Earth were flat, it shouldn't have any function to account for the Earth's curvature. However… this is not the case! The software does indeed have a function to account for curvature, as can be verified in the software's help documentation:

https://help.autodesk.com/view/MAP/2025/ENU/?guid=GUID-F4E804E1-F61A-4147-890A-1E52EE70A133

Here is a screenshot:


AutoCAD Map 3D 2025 Help
help.autodesk.com/view/MAP/2025/ENU/?guid=GUID-F4E804E1-F61
VPN
Help Home
Sign In
English (US)
AUTODESK AutoCAD Map 3D 2025
Enter a keyword
To Measure Geodetic Distance
SHARE
You can measure the geodetic distance between points in your map. Geodetic distance takes into account the curvature of the Earth. Therefore, the geodetic distance between any two points is longer than the straight line distance between the same two points.
To measure geodetic distance
1. Click Analyze tab ➤ Geo Tools panel ➤ Geo Distance.
2. At the MAPDIST prompt, specify the starting point by clicking in the map or typing the coordinates of the point.
3. At the second prompt, specify the end point by clicking in the map or typing the coordinates of the point.
The results of the calculation are displayed on the command line. If you do not see the command line, press Ctrl + 9 to display it.
Related Tasks
To Work With Coordinate Tracking
To Add Distances
To Display Continuous Distance
To Display Angle Information
To Display COGO Information for Lines and Arcs
To Display the Slope Between Two Points
Was this information helpful?
Yes
No
AUTODESK
Except where otherwise noted, this work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License.
Please see the Autodesk Creative Commons FAQ for more information

It is also easy to check that the button for calculating distances on a curved Earth does indeed exist in the software, as shown below:



translation into engli

(#263) Furuno ECDIS Marine Navigation System

The Furuno ECDIS (Electronic Chart Display and Information System) marine navigation system is a sophisticated tool designed to help mariners navigate safely and comply with international maritime regulations. It is part of the ECDIS family of systems, which are electronic charting and information devices recognized by the International Maritime Organization (IMO) as replacements for paper nautical charts.

Furuno develops benches and software whose prices range from a few thousand to several tens of thousands of euros.

Below is a fully installed and functional bench:

A station sold on its own looks more like this:

translation pending

Figure 149 ECDIS900 MK5A

We can find more products on their website:

https://www.furuno.com/en/products/ecdis

What interests us is the software installed on these control stations. As the screenshot below shows, when you zoom out sufficiently from the software, you see a globe and not a flat Earth… (you can see a video of this here: https://vm.tiktok.com/ZNewXSVLq/):

Figure 150 Furuno 3000 Series ECDIS

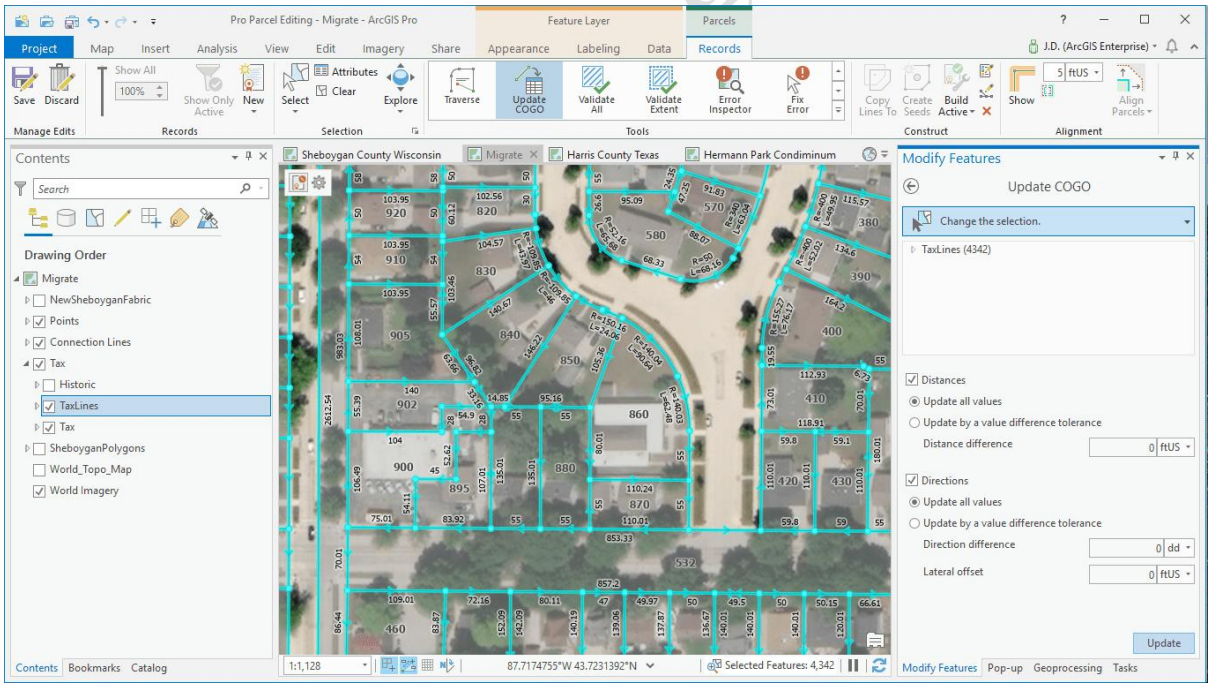
(#264) ArcGIS Pro

ArcGIS is a geographic information system (GIS) platform developed by Esri, a world leader in its field. It allows users to create, analyze, visualize, and share geospatial data - that is, information related to specific locations on the Earth's surface.

Here are some of ArcGIS's main features:

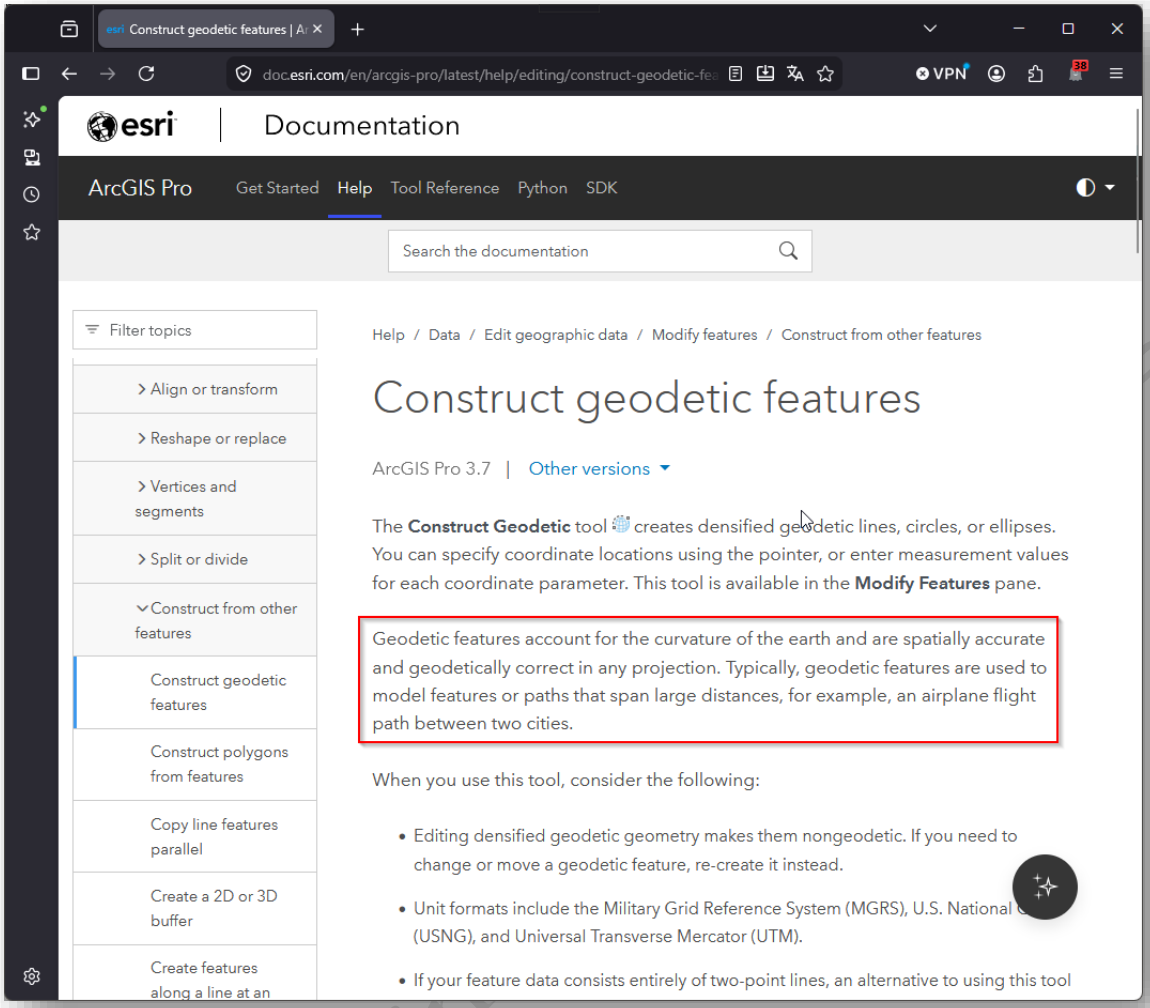
- Mapping and visualization: Create interactive and dynamic maps.
- Spatial analysis: Perform sophisticated analyses to uncover spatial trends and relationships.
- Data management: Store, manage and access geospatial data via databases and online services.
- Sharing and collaboration: Publish maps and web applications for easy access by other users.

What distinguishes ArcGIS is its great flexibility and ability to integrate many types of data and file formats, making it a valuable tool for urban planners, research environments, businesses and many other fields.



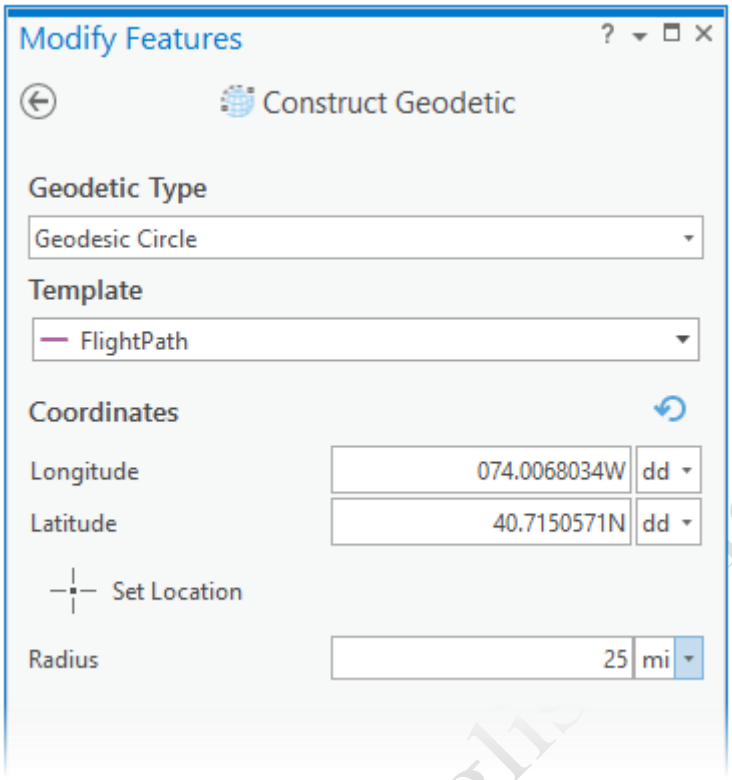
Because the Earth is curved, the software has a feature to take into account distances on the sphere, as indicated in the documentation on their website:

https://doc.esri.com/en/arcgis-pro/latest/help/editing/construct-geodetic-features.html


Construct geodetic features | Ar
doc.esri.com/en/arcgis-pro/latest/help/editing/construct-geodetic-fe
VPN
esri
Documentation
ArcGIS Pro
Get Started
Help
Tool Reference
Python
SDK
Search the documentation
Filter topics
Align or transform
Reshape or replace
Vertices and segments
Split or divide
Construct from other features
Construct geodetic features
Construct polygons from features
Copy line features parallel
Create a 2D or 3D buffer
Create features along a line at an
Help / Data / Edit geographic data / Modify features / Construct from other features
Construct geodetic features
ArcGIS Pro 3.7 | Other versions
The Construct Geodetic tool creates densified geodetic lines, circles, or ellipses. You can specify coordinate locations using the pointer, or enter measurement values for each coordinate parameter. This tool is available in the Modify Features pane.
Geodetic features account for the curvature of the earth and are spatially accurate and geodetically correct in any projection. Typically, geodetic features are used to model features or paths that span large distances, for example, an airplane flight path between two cities.
When you use this tool, consider the following:
Editing densified geodetic geometry makes them nongeodetic. If you need to change or move a geodetic feature, re-create it instead.
Unit formats include the Military Grid Reference System (MGRS), U.S. National
(USNG), and Universal Transverse Mercator (UTM).
If your feature data consists entirely of two-point lines, an alternative to using this tool

Proof of the tool:

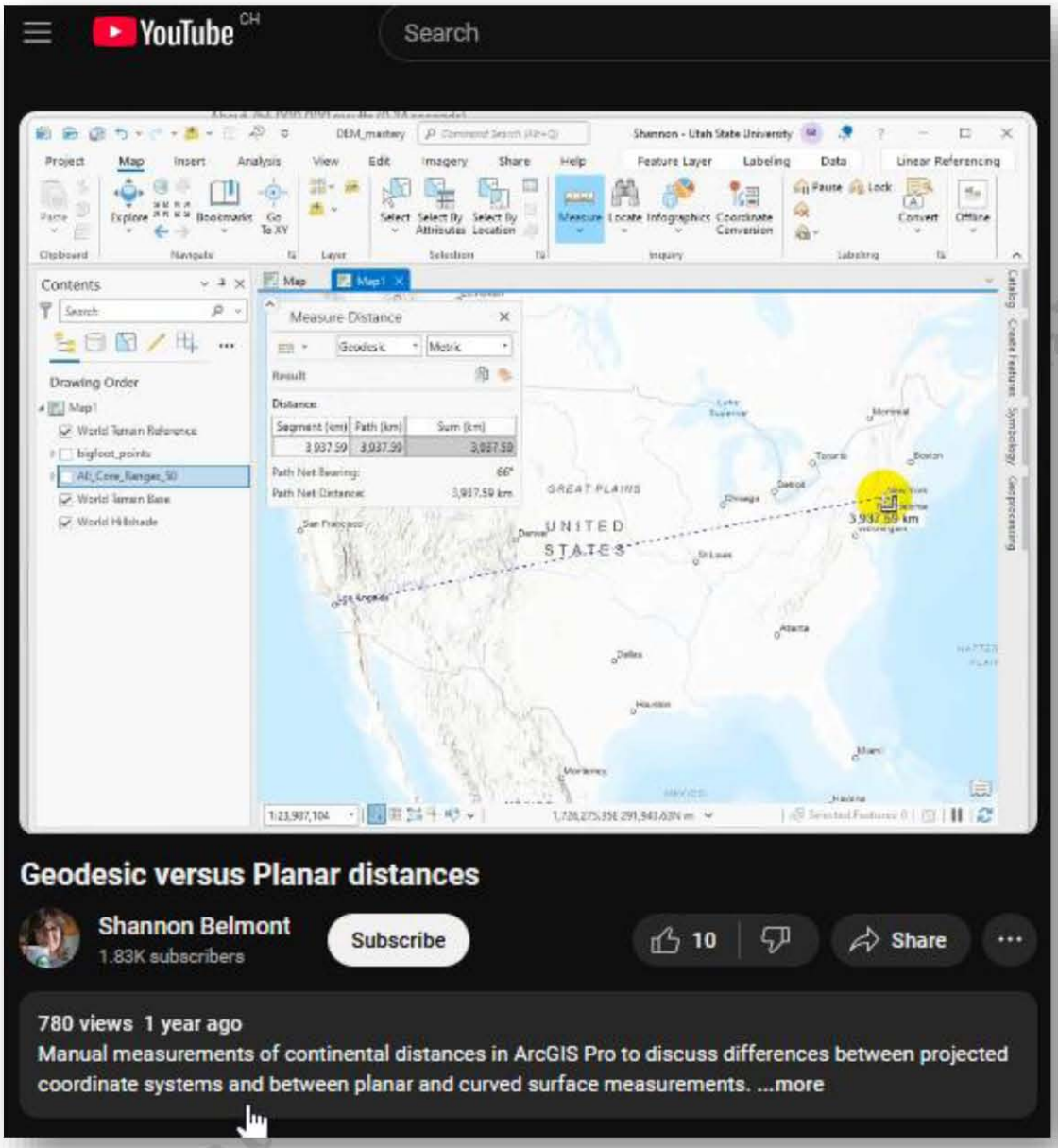
translation in



Alternatively, here's a YouTube video demonstrating how to use the feature:

https://www.youtube.com/watch?v=6uzAKem-x6Q

translation into english ongoing


YouTube CH
Search
Geodesic versus Planar distances
Shannon Belmont
1.83K subscribers
Subscribe
10
Share
780 views 1 year ago
Manual measurements of continental distances in ArcGIS Pro to discuss differences between projected coordinate systems and between planar and curved surface measurements. ...more

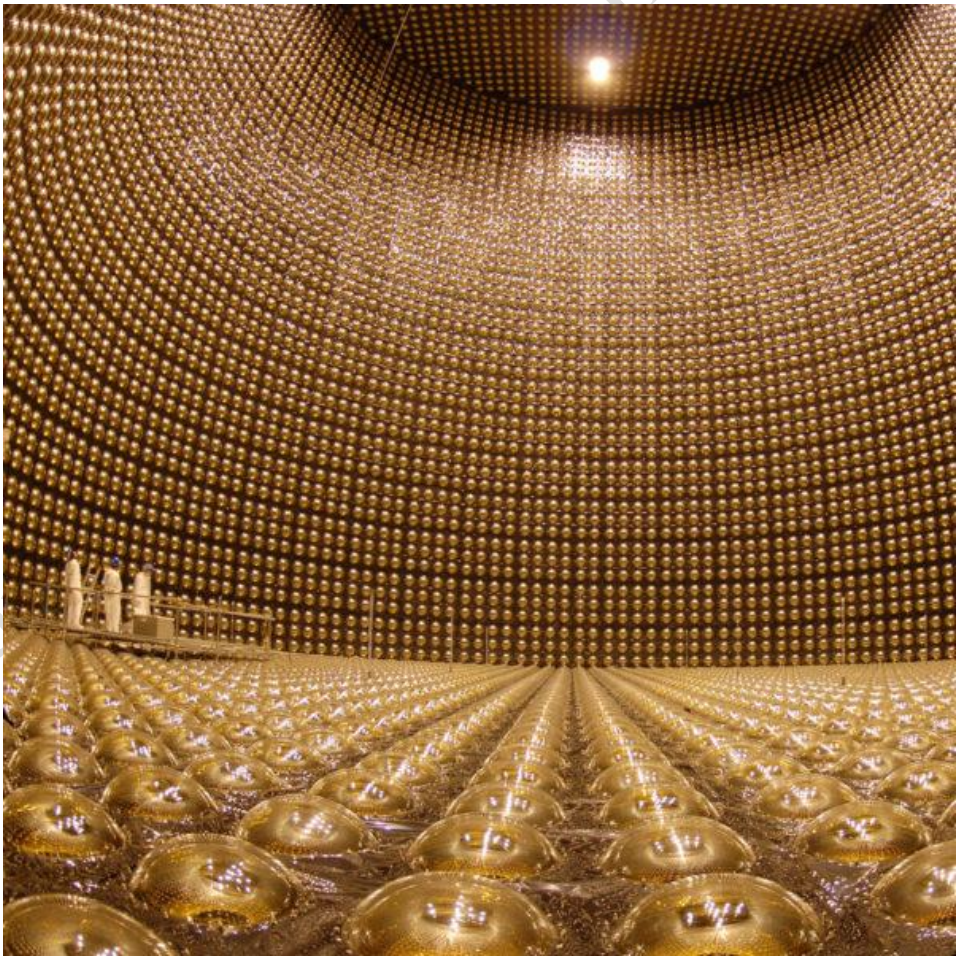
translation

Neutrino Detectors

The majority of neutrinos do not interact with matter. Several detectors exist on Earth to measure and quantify certain stellar phenomena (solar activity, supernovae). Not only did the construction of these detectors have to take into account the curvature of the Earth, as we will see by showing press releases directly from the official websites of these detectors, but some of them also make measurements that allow us to directly prove, through the time-of-flight of neutrinos, that the Earth is not flat.

(#265) T2K (Tokai to Kamioka/Japon)

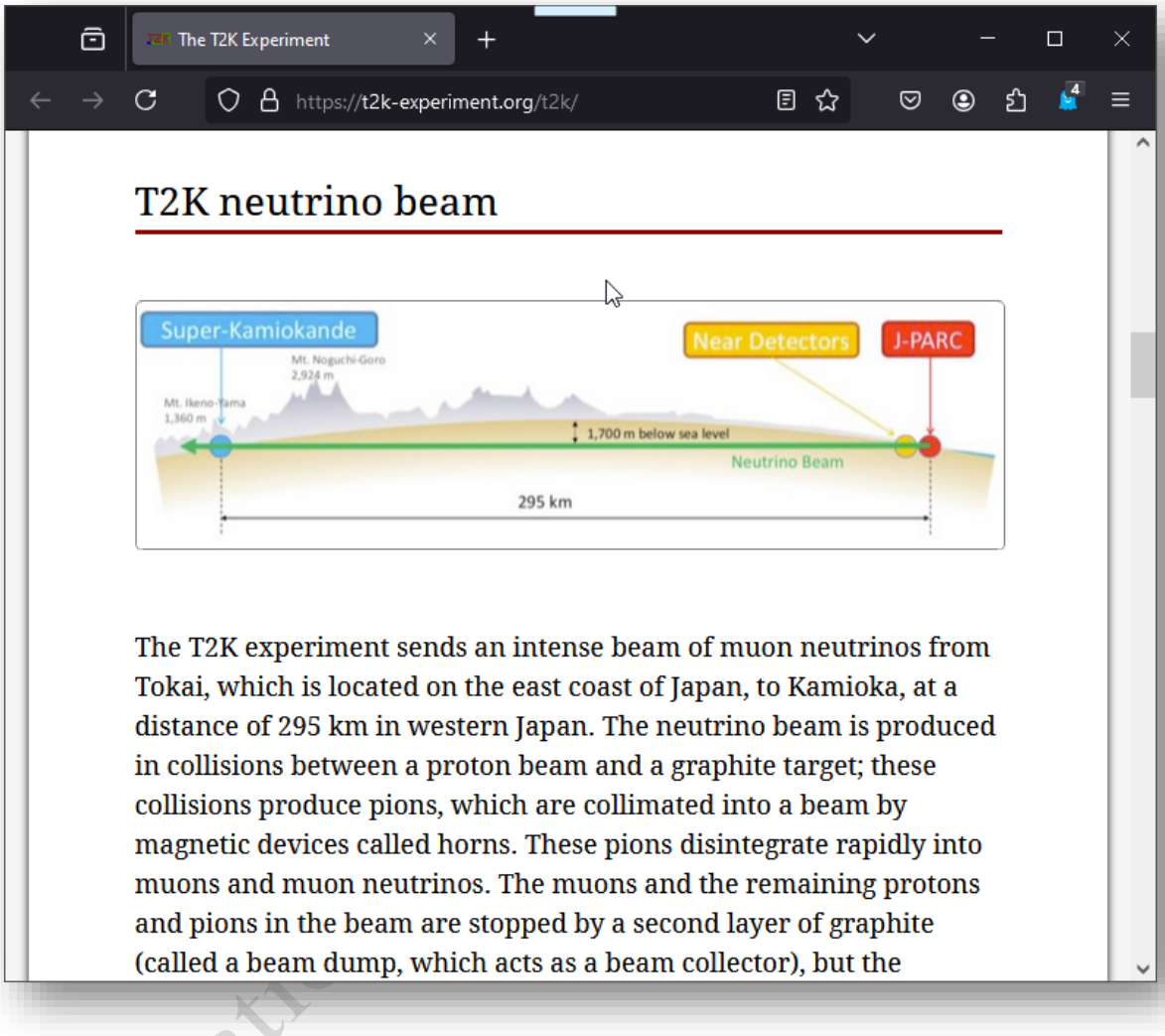
T2K (Tokai to Kamioka) is a particle physics experiment located in Japan, involving collaborations from numerous countries, with a significant contribution from Europe (50% of the collaborators). It is a neutrino oscillation experiment measuring a muon neutrino beam at short (280 m) and long (295 km) distances. It is a successor to the K2K experiment. The J-PARC accelerator at Tokai produces the beam, which is pointed at the Super-Kamiokande far detector. The beam is off-axis by 2/5°, resulting in a sharper spectrum at an energy more suitable for oscillations, and also reducing background noise. The main goal of T2K is to measure the oscillation of muon neutrinos into electron neutrinos in order to measure θ_{13}, the last unmeasured parameter of the PMNS Matrix.



As we can see it on the detector's official website:

https://t2k-experiment.org/t2k/

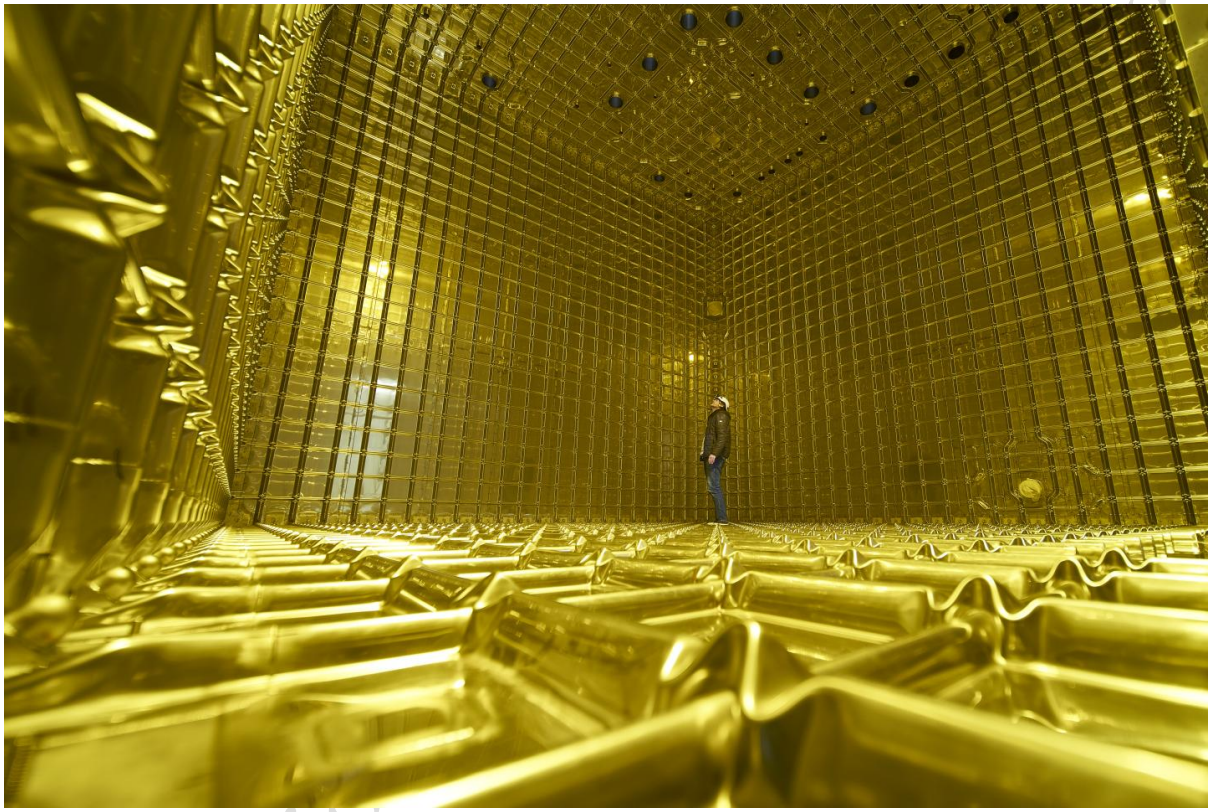
The Earth is represented as curved (obviously this does not constitute scientific proof, but for flat-Earthers a drawing is often considered proof…):


The T2K Experiment
https://t2k-experiment.org/t2k/
T2K neutrino beam
Super-Kamiokande
Mt. Noguchi-Goro
2,924 m
Mt. Ikeno-Yama
1,360 m
Near Detectors
J-PARC
1,700 m below sea level
Neutrino Beam
295 km
The T2K experiment sends an intense beam of muon neutrinos from Tokai, which is located on the east coast of Japan, to Kamioka, at a distance of 295 km in western Japan. The neutrino beam is produced in collisions between a proton beam and a graphite target; these collisions produce pions, which are collimated into a beam by magnetic devices called horns. These pions disintegrate rapidly into muons and muon neutrinos. The muons and the remaining protons and pions in the beam are stopped by a second layer of graphite (called a beam dump, which acts as a beam collector), but the

Unfortunately, the T2K only measures relative travel times between different neutrinos as of the date we write these lines (November 2024). Therefore, we have no way of demonstrating that, based on the "flight time" of neutrinos, they travel around a globe and not a flat Earth.

(#266) DUNE (Deep Underground Neutrino Experiment/Illinois U.S.A.)

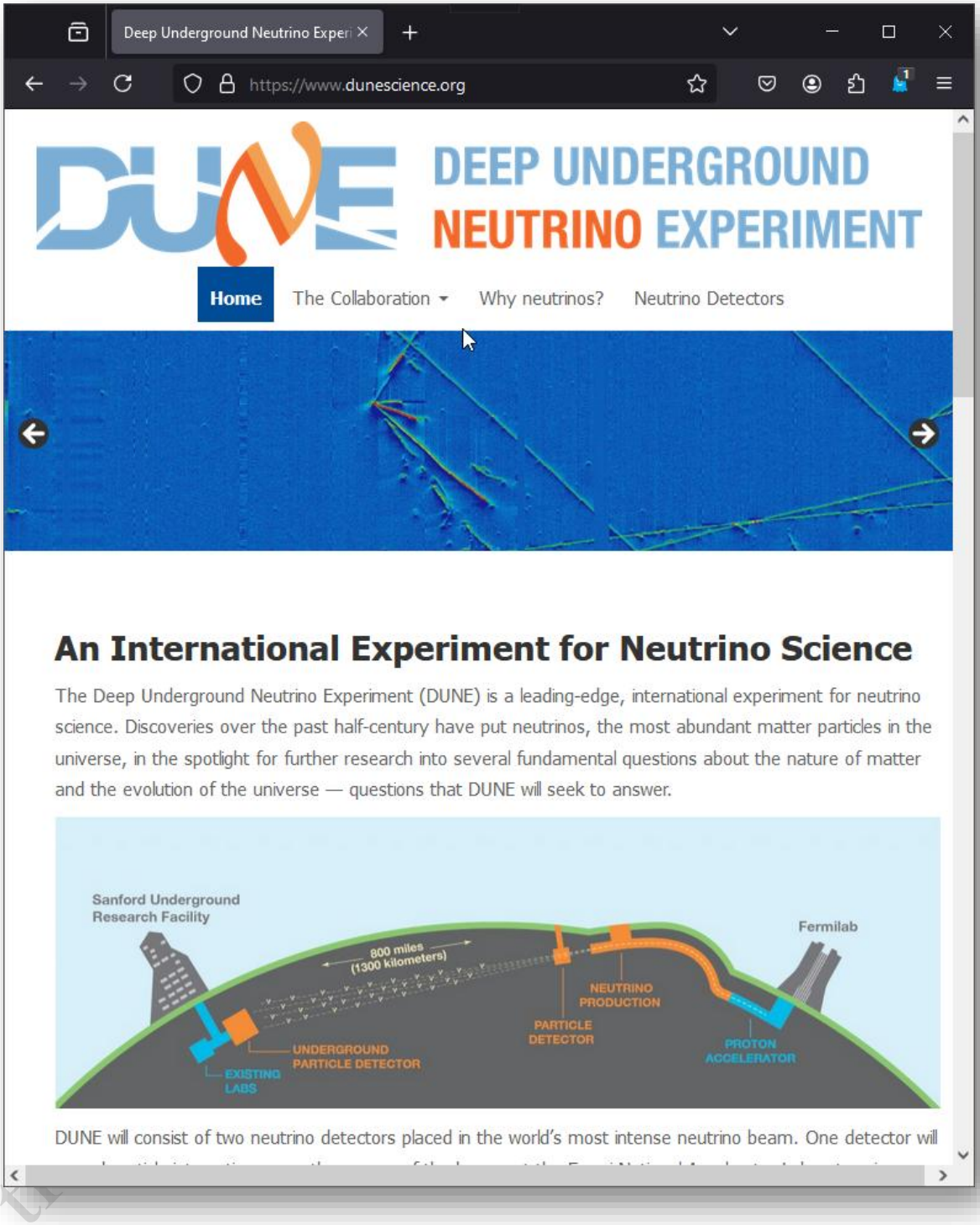
The Deep Underground Neutrino Experiment (DUNE) is a neutrino experiment currently under construction, with a near detector at Fermilab and a far detector at the Sanford Underground Research Facility that will observe neutrinos produced at Fermilab. An intense beam of trillions of neutrinos from Fermilab's production facility (in Illinois) will be sent over a distance of 1,300 kilometers (810 miles) to understand the role of neutrinos in the universe. More than 1,000 people are working on the project. The experiment is designed for a 20-year data collection period.



The project is under construction, but… we can see something interesting on the official DUNE project website:

https://www.dunescience.org/

translatio


Deep Underground Neutrino Experi
https://www.dunescience.org
DEEP UNDERGROUND
NEUTRINO EXPERIMENT
Home
The Collaboration
Why neutrinos?
Neutrino Detectors
An International Experiment for Neutrino Science
The Deep Underground Neutrino Experiment (DUNE) is a leading-edge, international experiment for neutrino science. Discoveries over the past half-century have put neutrinos, the most abundant matter particles in the universe, in the spotlight for further research into several fundamental questions about the nature of matter and the evolution of the universe — questions that DUNE will seek to answer.
Sanford Underground Research Facility
800 miles (1300 kilometers)
Fermilab
NEUTRINO PRODUCTION
PARTICLE DETECTOR
PROTON ACCELERATOR
UNDERGROUND PARTICLE DETECTOR
EXISTING LABS
DUNE will consist of two neutrino detectors placed in the world's most intense neutrino beam. One detector will

The Earth is also depicted as curved!

(#267) MINOS Experiment

MINOS (Main Injector Neutrino Oscillation Search) is a particle physics experiment designed to assess the behavior of neutrinos over long distances. They travel from their production at Fermilab (using the NuMI particle accelerator, which is also used for the MINERvA experiment) to the detector, 735 kilometers away. The disappearance of muon neutrinos is an indicator of the presence of massive neutrinos and of the phenomenon of neutrino oscillation (flavor change).

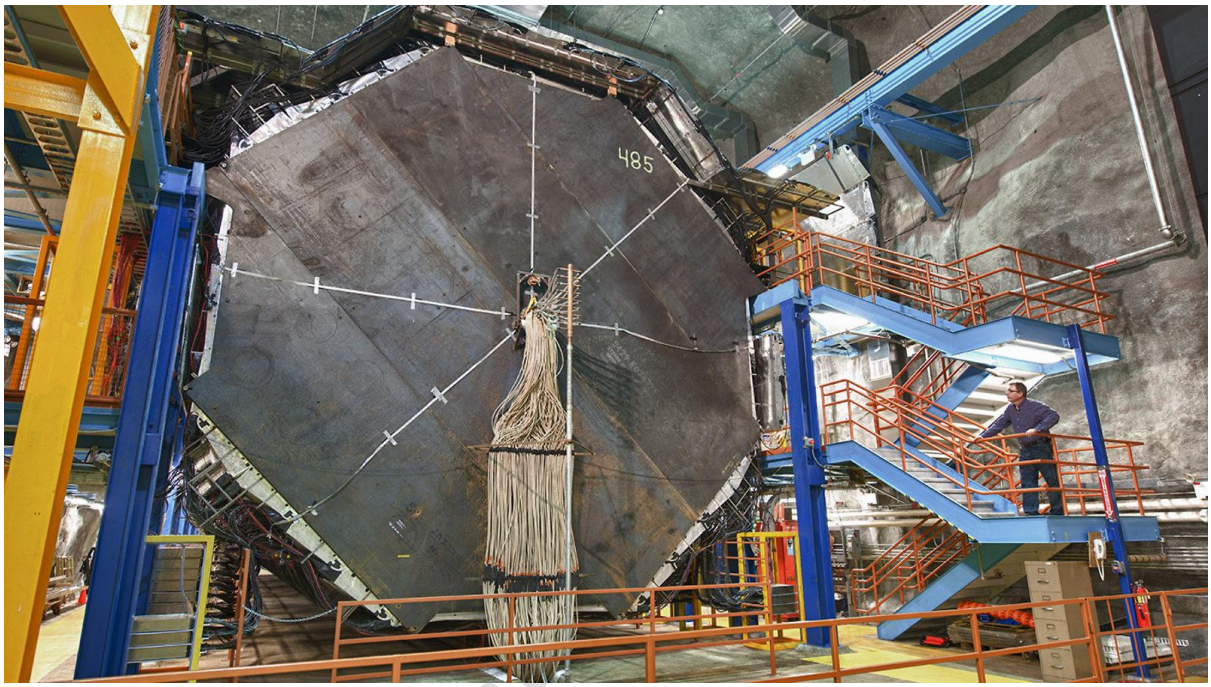


Figure 151 MINOS detector at Fermilab

On the official Fermilab file server, we have the following internal document:

https://lss.fnal.gov/archive/thesis/2000/fermilab-thesis-2012-03.pdf

On page 31 we have evidence that they must have taken into account the curvature of the Earth:

translation in

2.0 THE MINOS BEAM AND DETECTORS

The MINOS Experiment is made up of the NuMI (Neutrinos at the Main Injector) high intensity neutrino beam and two nearly identical tracking calorimeters: The Near Detector at Fermilab and the Far Detector in the Soudan Mine in Northern Minnesota. Side and top views of the detectors' locations are shown in Fig. 2.1.

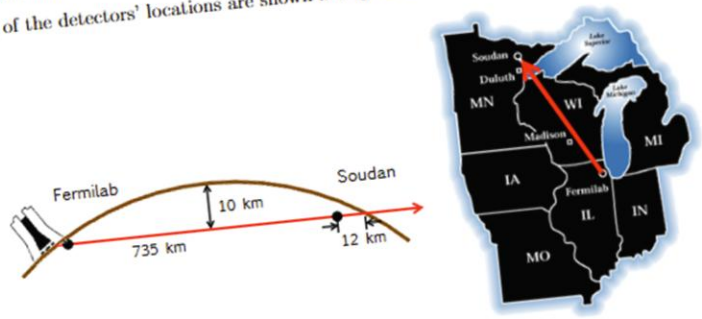


Figure 2.1: Side view (left) and bird's eye view diagrams of the locations of the MINOS detectors. Due to the Earth's curvature the beam is aimed downwards, travels through the crust to Soudan and exits the surface to the north of the Far Detector. The figure is adapted from [66].

31

There is also the following document (MINOS detector design report):

https://lss.fnal.gov/archive/design/fermilab-design-1998-02.pdf

where on page 3-5, we have:

3.3 Geographical layout of the experiment

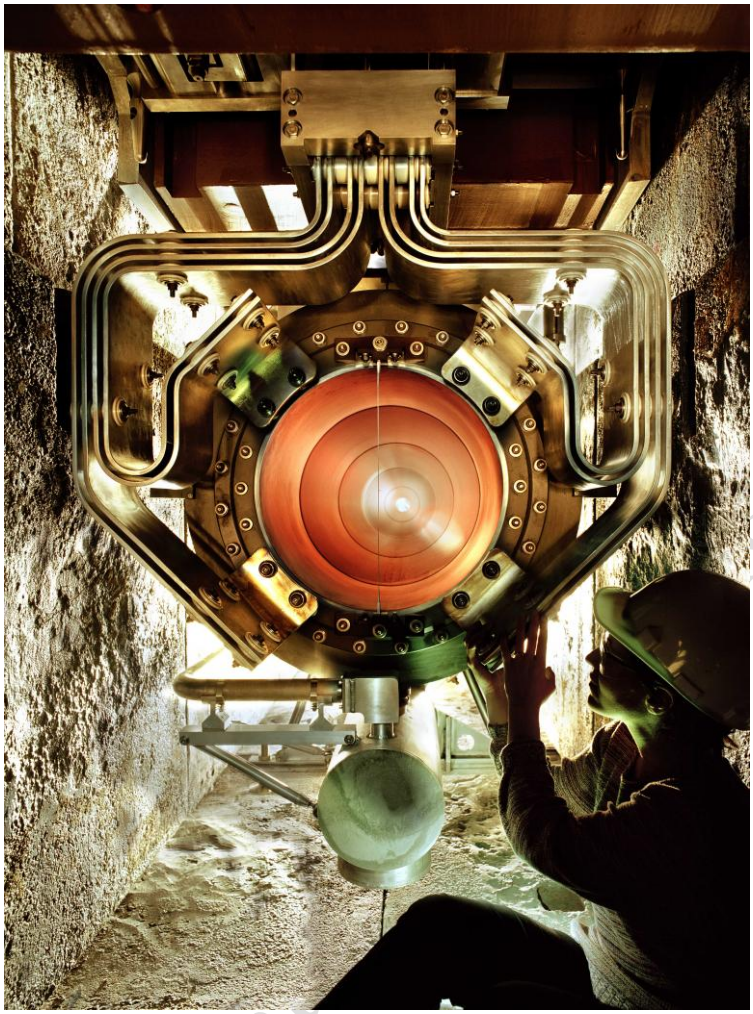
The "map" of the experiment is illustrated in Figure 3.1. The neutrino beam is produced by the 120 GeV protons from the Fermilab Main Injector and is aimed at the Soudan mine in northern Minnesota, some 730 km away. Because of the earth's curvature the parent hadron beam has to be pointed downward at an angle of 57 mrad.

Figure 3.1: The trajectory of the MINOS neutrino beam between Fermilab and Soudan. The beam must be aimed into the earth at an angle of 57 mrad to reach Minnesota.

The hadron beam decay pipe will be 675 m long, a compromise between our desire to obtain the maximum number of π and K decays and the cost of the civil construction. The

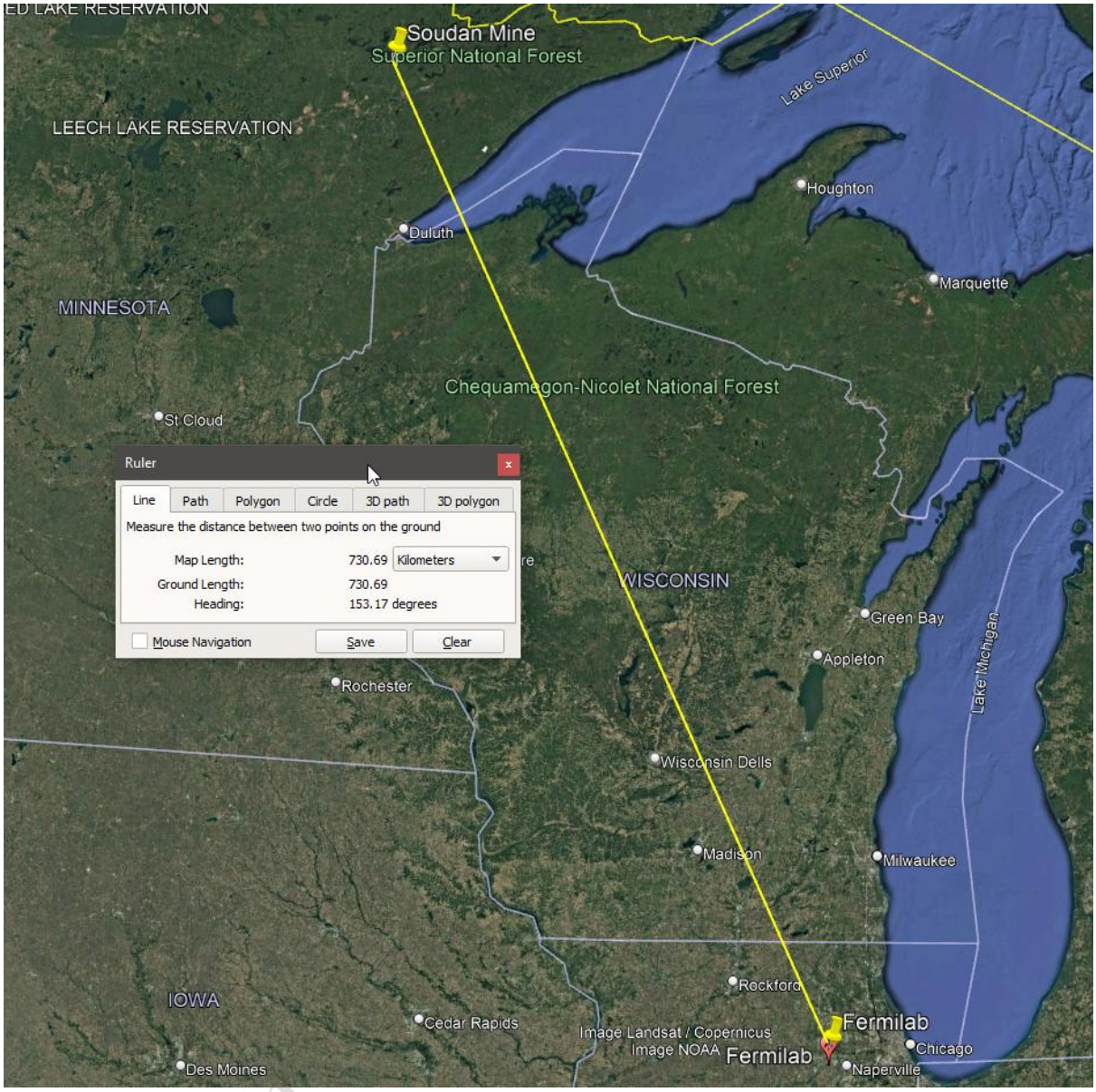
translation

Below we have a picture of the primary hadron beam source:



The first ground-based measurement of absolute transit time was performed by MINOS (2007) at Fermilab. To generate neutrinos (the so-called “NuMI” beam), they used Fermilab's main injector, through which 120 GeV protons were directed toward a graphite target in 5 to 6 batches per discharge. The resulting mesons decayed in a 675-meter-long decay tunnel into muon neutrinos (93%) and muon antineutrinos (6%). The travel time was determined by comparing the arrival times at the near and far detectors MINOS, separated by 734 km. The clocks of the two stations were synchronized by GPS, and long optical fibers were used for signal transmission.

translation in progress



They measured an early arrival of neutrinos of approximately 126 ns. Thus, the relative velocity difference was $5.1 \pm 2.9 \cdot 10^{-5}$ (68% confidence limit). This corresponds to 1.000051 ± 29 times the speed of light, therefore apparently faster than light. The main source of error was uncertainty in the optical fiber's timing. The statistical significance of this result was less than 1.8σ, so it was not significant, as 5σ is required for acceptance as a scientific discovery.

At a 99% confidence level, it has been given:

$$-2.4 \cdot 10^{-5} < \frac{v - c}{c} < 12.6 \cdot 10^{-5}$$

a neutrino speed greater than $0.999976c$ and less than $1.000126c$. Thus, the result is also consistent with subluminal speeds.

On a flat Earth, the distance between the transmitter and the detector is not 734 km, but:

http://walter.bislins.ch/bloge/index.asp?page=Distances+on+Globe+and+Flat+Earth

Calculation Form

You can enter Latitude/Longitude in degrees with decimal point (e.g. 54.5°) or degrees, minutes and seconds (e.g. 54° 30min). Latitudes on the Southern Hemisphere and Longitudes westerly of the 0-Meridian must be entered as negative values. See Input Format for Latitude and Longitude for some input examples.

	Latitude			Longitude			→DMS	→Deg	Reset
P1	47 °	49 min	9 sec	92 °	14 min	30 sec			
P2	41 °	50 min	51 sec	88 °	15 min	30 sec			

Computed Distances from P1 to P2		Planet Sizes used for Calculation	
Globe	734.309011 km	RadiusGlobe	6,371 km
Flat Earth	749.835818 km	FE-PoleEquator	10,007.543398 km

Units ◉ km ○ nmi (nautical miles) ○ mi (statute miles)

This represents a difference of approximately 15 km. In terms of light-time, this translates to a difference of 5 microseconds. This would give an upper limit for the speed of light of 1.0211*c*, significantly higher than the 1.000126*c* of the 99% confidence interval measured and calculated above.

Yet another proof that the Earth is a globe!

translation into englis

(#268) CNGS (CERN Neutrinos to Gran Sasso/Italie)

The CERN Neutrinos to Gran Sasso (CNGS) project aimed to unravel some of the mysteries surrounding neutrinos, those light, neutral particles that interact very little with matter. As far as we know there are three types, or "flavors", of neutrinos: the electron neutrino, the muon neutrino, and the tau neutrino. But neutrinos are, it seems, the chameleons of the subatomic world because they can switch from one flavor to another. This phenomenon, called "oscillation", occurs when neutrinos travel long distances through matter. It is directly related to the extremely small mass of these particles.

Between July 2006 and December 2012, the CNGS project involved sending muon neutrinos from CERN to the Gran Sasso Laboratory (LNGS) in Italy, a distance of 732 kilometers. Neutrinos interact so weakly with other particles that they pass easily through rock. At Gran Sasso, the OPERA and ICARUS experiments attempted to identify the tau neutrinos produced by the muon neutrinos.

To produce the neutrino beam, a proton beam from CERN's SPS was directed at a graphite target. The collision produced particles called pions and kaons, which a system of two magnetic lenses focused to form a single beam. In this beam, these two types of particles traveled in parallel to the Gran Sasso laboratory. The pions and kaons then decayed into muons and muon neutrinos in a kilometer-long tunnel. At the tunnel's exit, an 18-meter-thick block of graphite and metal absorbed any protons, pions, and kaons that had not decayed. Because the rock blocked the passage of muons, only the muon neutrinos continued their underground journey to the Gran Sasso laboratory.

translation engine ongoing

First, as with the previous detectors, note that on the official CERN website, we have:

https://cds.cern.ch/journal/CERNBulletin/2003/29/News%20Articles/627593?ln=fr

CNGS : La voie vers Gran Sasso

https://cds.cern.ch/journal/CERNBulletin/2003/29/News Articles/627593?ln

Particules «passe-murailles»

Le projet CNGS consiste à produire au CERN en 2006 un faisceau de neutrinos de haute énergie et à l'envoyer dans la direction du laboratoire souterrain de Gran Sasso, où il sera analysé. Pour cela, des protons issus du SPS seront transportés le long d'une ligne de transfert d'environ 800 mètres avant d'entrer dans une «chambre cible» de 150 mètres de long et 6,5 mètres de diamètre. A cet endroit, les protons bombarderont une cible de graphite pour donner naissance à des pions et des kaons.

Les particules produites entreront alors dans un système de deux cornes magnétiques qui focaliseront les pions et les kaons en un faisceau parallèle dirigé vers le Gran Sasso (voir l'encadré «Les cornes magnétiques en cours d'assemblage»). Puis, le long d'un tunnel de 1000 mètres, pions et kaons se désintègreront en muons et neutrinos du muon. A la sortie du tunnel, un «hadron stop» absorbera les hadrons (protons, pions et kaons restants). A sa suite, deux détecteurs à muons mesureront le flux de muons produits, et donc indirectement celui de neutrinos du muon.

Le faisceau de neutrinos du muon quittera finalement les galeries du CERN. Et les neutrinos, tels des passe-murailles, entameront leur course de quelque 730 km à travers l'écorce terrestre pour rejoindre le laboratoire souterrain de Gran Sasso, où deux immenses détecteurs les attendront : ceux des expériences ICARUS et OPERA.

La trajectoire du faisceau de neutrinos du CERN jusqu'au laboratoire de Gran Sasso situé sous 1400 mètres de roches, à 120 km de Rome.

Structures souterraines

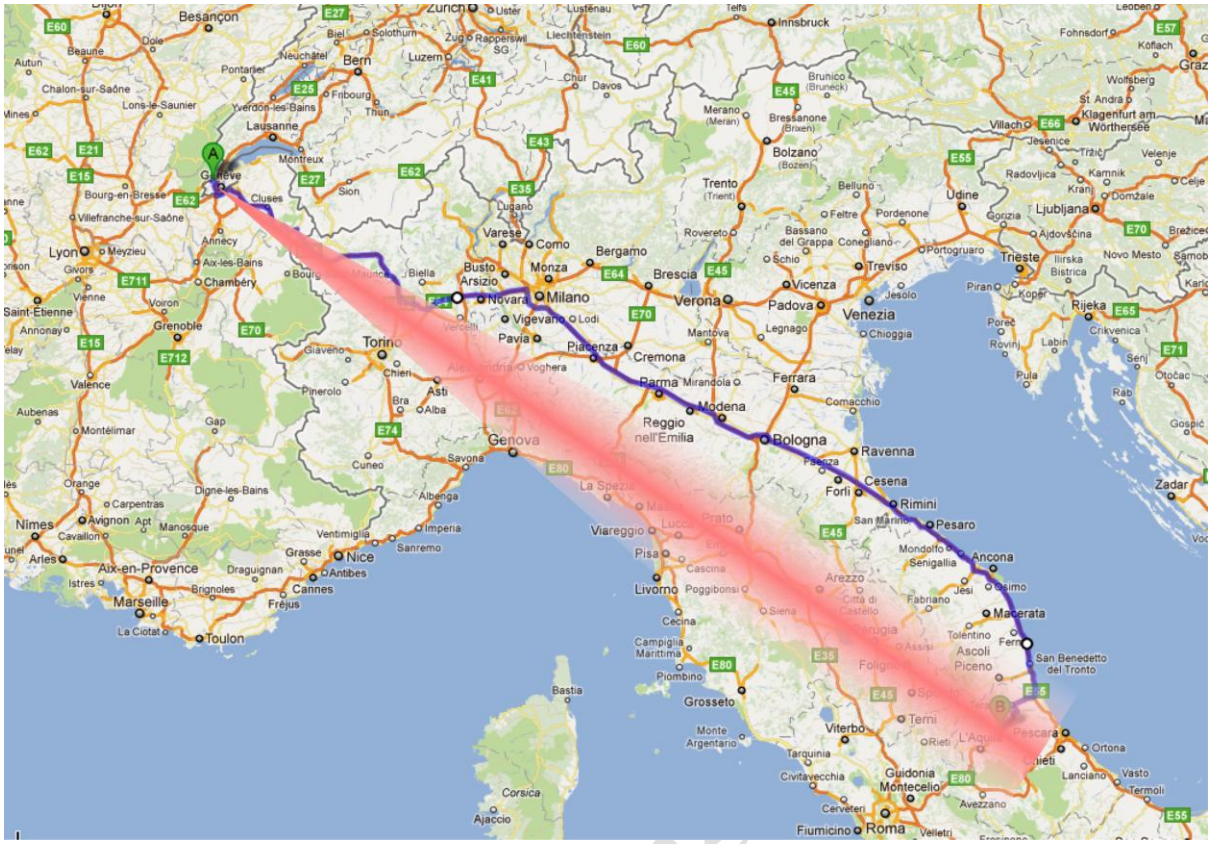
Toutes les structures souterraines du projet sont aujourd'hui réalisées. 45000 mètres cubes de déblais ont été excavés depuis septembre 2000. En mars 2002, le tunnelier finissait de creuser la molasse du bassin lémanique, de la chambre cible en passant par le tunnel de désintégration, et jusqu'à l'emplacement du «hadron stop». En plus des haveuses classiques, une haveuse programmée à l'aide d'un petit ordinateur de bord a permis d'améliorer les cadences d'excavation dans les endroits les plus difficiles.

Le bétonnage s'est déroulé au fur et à mesure de l'avancée des travaux. « Pour la première fois au CERN, les galeries d'accès ont été finies au béton projeté, ce qui rend leurs parois moins lisses que celles des tunnels. Comme il ne sera pas non plus nécessaire de peindre ces galeries, nous gagnons du temps et de l'argent », précise Natacha Lopez.

translat

Oh look, another globe is depicted, not a flat Earth…

For those who prefer to see this on a road map:



The CNGS project connects the Super Proton Synchrotron (SPS) accelerator at CERN Geneva (Switzerland) to the Gran Sasso mountain in Italy, a distance of approximately 732 kilometers. The difference between neutrino travel times and the speed of light along the 732 km beam path was measured at -1.9±3.7 nanoseconds (Measurement of the neutrino velocity with the OPERA detector in the CNGS beam, 2012), which is statistically consistent with a zero difference. In this case, if a flat Earth model had been used, the beam path distance would have been equal to the surface distance from CERN to the Gran Sasso, approximately 410 meters further. This would have resulted in an additional 410/c = 1367 nanoseconds difference in neutrino travel times, meaning the neutrinos would be traveling much faster than the speed of light.

In a document saved on the CERN file server, we also have confirmation that the curvature of the Earth is considered in the experiment:

https://cds.cern.ch/record/793156/files/spsc-2004-025.pdf

at page 8 :

beam is already 44 km above the detector. This defines the 'magic' angle $1/\gamma_\pi$, which in turn fixes the monochromatic neutrino energy from pion decay at this location to be 800 MeV – incidentally the energy required for the second oscillation maximum for $\Delta m^2_{23} = 2.5 \times 10^{-3}$ eV^2. For illustration, the resulting oscillatory amplitude for off-axis neutrinos is given in Fig. 2 as a function of the baseline, for $\Delta m^2_{23} = 2.5 \times 10^{-3}$ eV^2 and for $\Delta m^2_{23} = 1.0 \times 10^{-3}$ eV^2. For baselines smaller than 1200 km, the neutrino energy is considered constant since a potential detector would be located on the line where the cone with opening angle $1/\gamma_\pi$ intersects with the surface of Italian soil; the neutrino energy equals the one at 1200 km. Beyond 1200 km, the oscillation is faster because of the combined effect of increasing the baseline and reducing the neutrino energy when moving downstream and thus increasing the off-axis angle because of Earth's curvature. Independently of Nature's precise choice of Δm^2_{23}, the detector locations sample well the oscillatory pattern and thus offer maximum sensitivity to the oscillation parameters.

For $\Delta m^2_{23} = 2.5 \times 10^{-3}$ eV^2, the next oscillation minimum occurs already at a baseline of $\sim$ 1300 km. Moving the detector downstream by some 100 km, both the leading and subleading oscillations are switched off: all $\nu_\mu \to \nu_e$ and $\nu_\mu \to \nu_\tau$ transitions have disappeared, the full flux of ν_μ is restored. The CC ν_μ events can be recorded through the quasi-elastic channel in the water Cherenkov detector nearly as easily as the CC quasielastic ν_e events.

Therefore, the experiment will unambiguously demonstrate the oscillatory pattern and the transition of one neutrino flavour to another, just by moving the detector from one location to another which is some 100 km downstream.

The position halfway in between, at some 1250 km, has maximum sensitivity to Δm^2_{23} and lends itself to its precise measurement.

The expected physics result is a high-precision measurement of θ_{23} and especially Δm^2_{23}, and a high-sensitivity search for a non-zero θ_{13}.

The data taking campaign will last about eight years.

Today, Δm^2_{23} is only known to $\sim 50\%$ and therefore the precise location of the oscillation maximum is not known. However, this does not invalidate the argument that a detector movement of order 100 km will explore the oscillatory pattern with high sensitivity.

3 The CNGS beam in off-axis geometry

Table 1 summarizes beam and detector parameters 1000 m below sea level, for a detector location in the Gulf of Taranto 1200 km from CERN.

Figure 3 shows the dependence of the neutrino energy E_ν on γ_π at a distance of 1200 km from CERN and a distance of 44 km from the CNGS beam axis, i.e. at an off-axis angle $\theta = 1/27.1$ rad. The important feature of the spectrum is its broad maximum at $E_\nu \sim 800$ MeV, which leads to a nearly monochromatic neutrino beam, essential for the goal of the experiment.

The CNGS beam [13] will be employed, with unchanged geometrical layout and with unchanged incident proton momentum of 400 GeV/c. However, target, horn and reflector need to be redesigned with a view to optimizing the flux of 3.8 GeV pions parallel to the axis of the decay tunnel.

The attractive feature of the off-axis geometry is that a broad band of pion momenta around 3.8 GeV/c, between 2 and 8 GeV/c about, is useful and yet leads to a nearly monoenergetic

Computer models

Flat Earth proponents have computer models of the flat Earth, but with virtual cameras always positioned above it. This allows them to hide the flaws and inaccuracies of their model from those who manipulate the simulation.

For example, proponents of the flat Earth are so far unable to provide a unique coherent numerical simulation that demonstrates the analemma or orientations of the phases of the moon, lunar eclipses, solar eclipses, the libration of the moon, etc. etc.

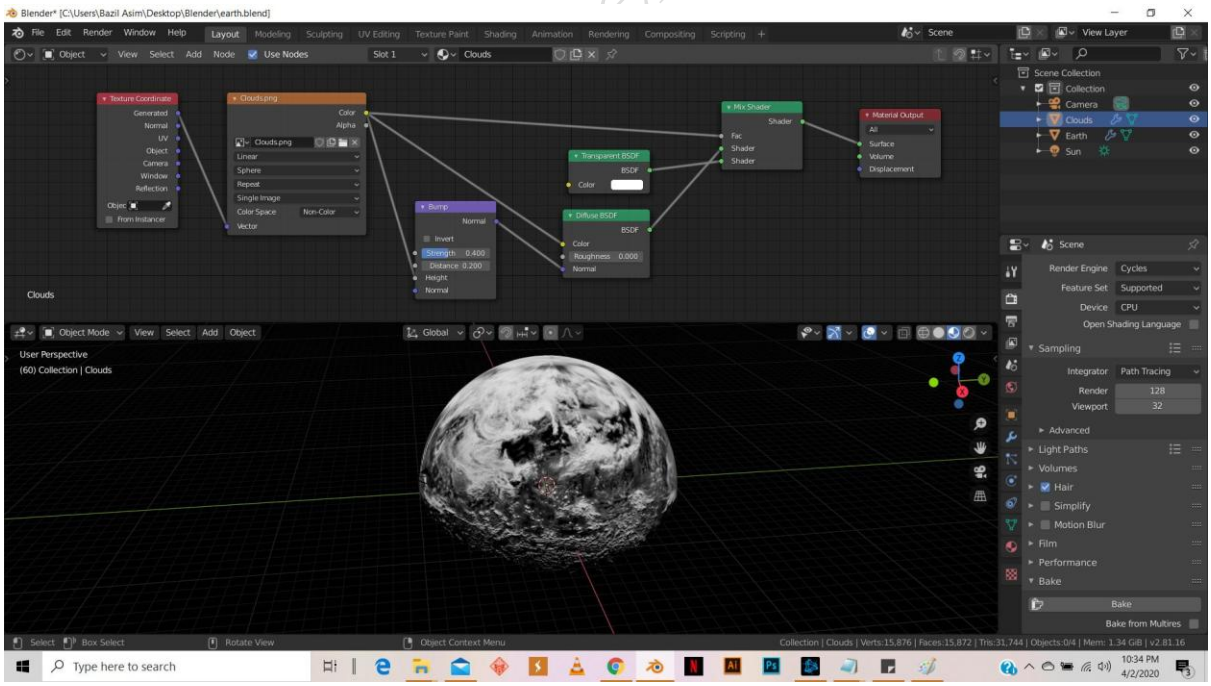
For example, here is a simulation available for download under the free 3D software Blender (the scales are not respected for simplifying reasons in this model).

You can download Blender for free via this link for Mac, Linux and Microsoft Windows:

https://www.blender.org/download/

Following several exchanges on social media, proponents of the flat Earth conspiracy theory told us that the model that best represented their view of things was based on the Gleason map.

Following several claims, " Le Chercheur " (member of the Science Squad on TikTok) began to create the model as described by the flat-Earthers using a 3d computer software, in order to make their claims visual and to be able to make a comparison between the global and flat models.



It is possible via this file to switch from the flat hypothesis to the spherical model in a few clicks and to switch from one camera to another (cameras judiciously placed and not trying to hide the defects under the rug…!).

english ongoing

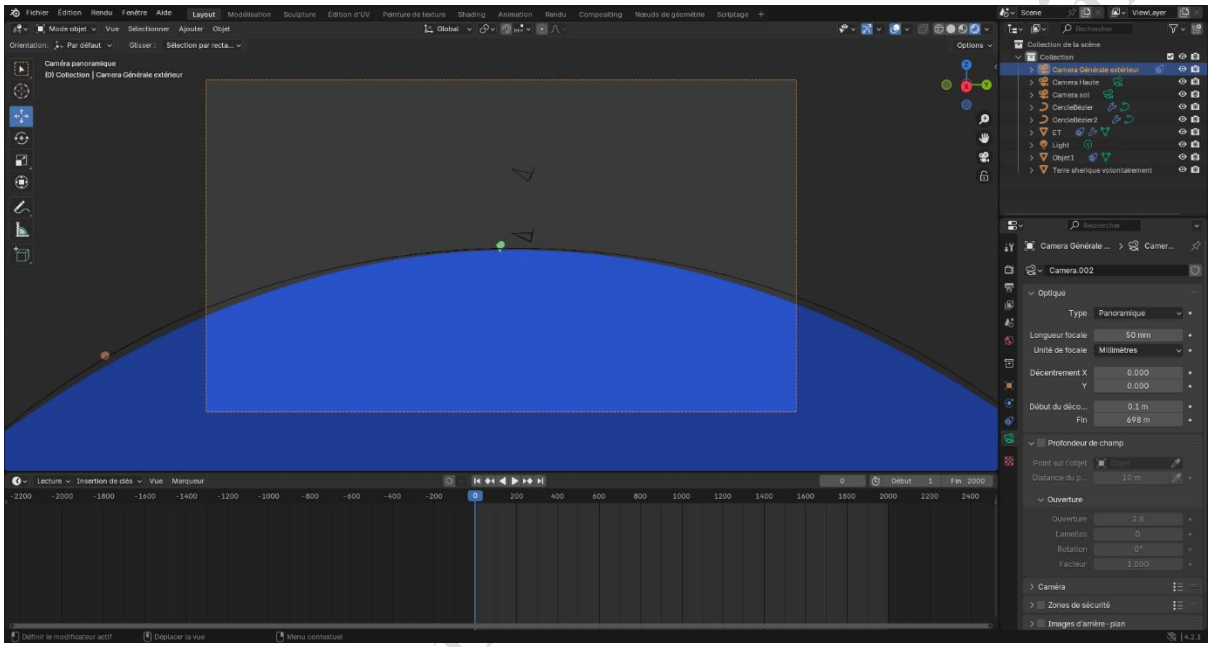
(#269) Horizon modelization (Blender)

Flat Earth proponents are unable to modelize with computers what they believe can be explained by the laws of linear perspective.

In the model below, we wanted to highlight observations that everyone can make!

In particular the faces of the Moon, as well as objects that disappear from the bottom due to the Earth's curvature.

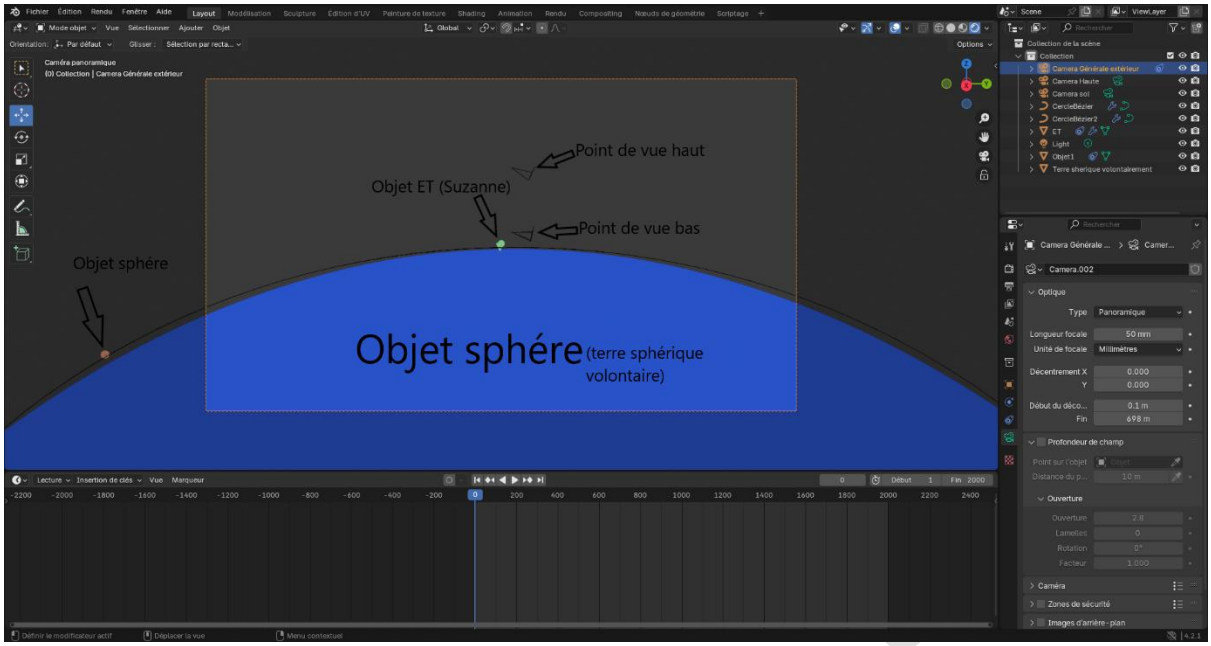
First modelisation: objects that disappear from below due to the Earth's curvature!



The scene:

The blue part is intentionally a sphere; there are several objects in this scene that follow a Bézier curve of the same diameter as the blue sphere:

- The 1st object is named *Suzanne* in the software, it is a monkey head implemented by default in Blender, no modification has been made to it in terms of modeling, only a green color has been applied to it for better visibility, and renamed *ET* on this model.
- The 2nd object is a simple orange sphere, also for better visibility.
- The 3rd object is a fixed general camera viewpoint, in a wide view of the scene.
- The 4th object is a fixed camera close to the blue sphere, which represents a person's point of view.
- The 5th object is a fixed camera at a height on the *Z* axis which represents a viewpoint of a person at a height, such as scaffolding, balcony, ladders etc.



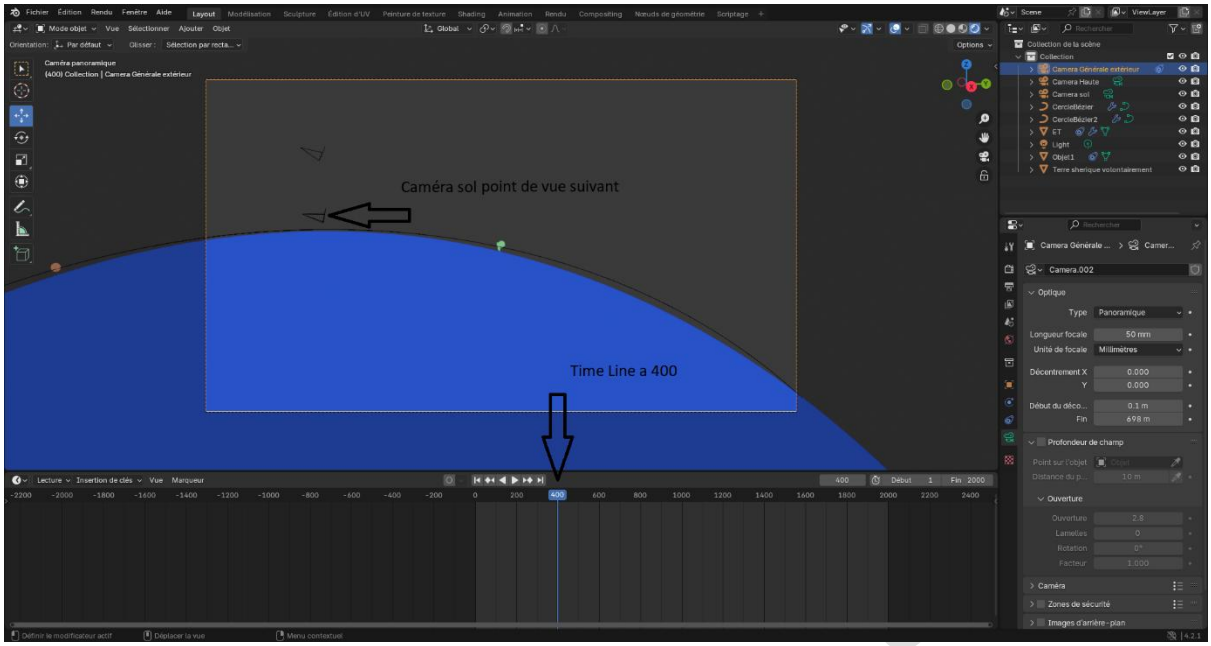
The test consists of seeing and understanding what would happen on the observation on a spherical model when an object moves away from the observer and what observations we would make if we gained altitude on this same model, thanks to the animation, (timeline at the bottom currently at frame #0).

The trajectory of the objects *Sphere* and *Suzanne* (*ET* in the model) goes towards the right of the modeling.

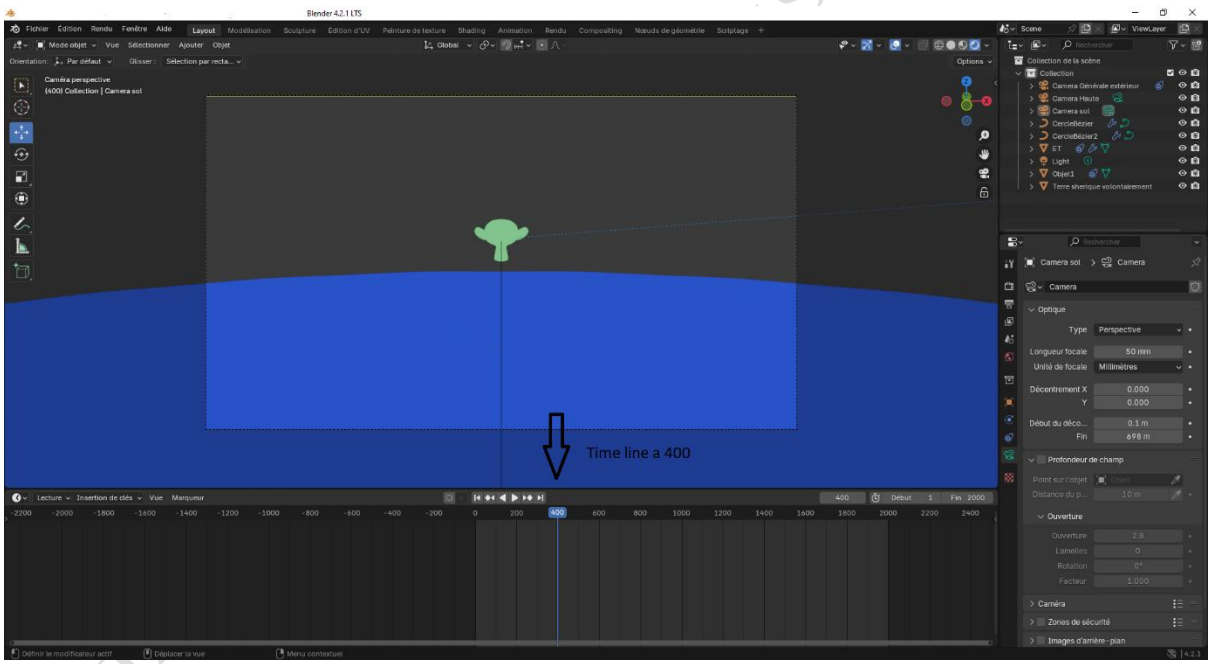
The Blender software has the particularity to "enter" inside the camera to take its point of view and we will use this particularity to simulate an observation, this is consistent with the reality of observations at this scale.

Let's advance the timeline to scroll through the animation to frame #400 and consider the view from the camera close to the ground and the wide camera:

translation into english

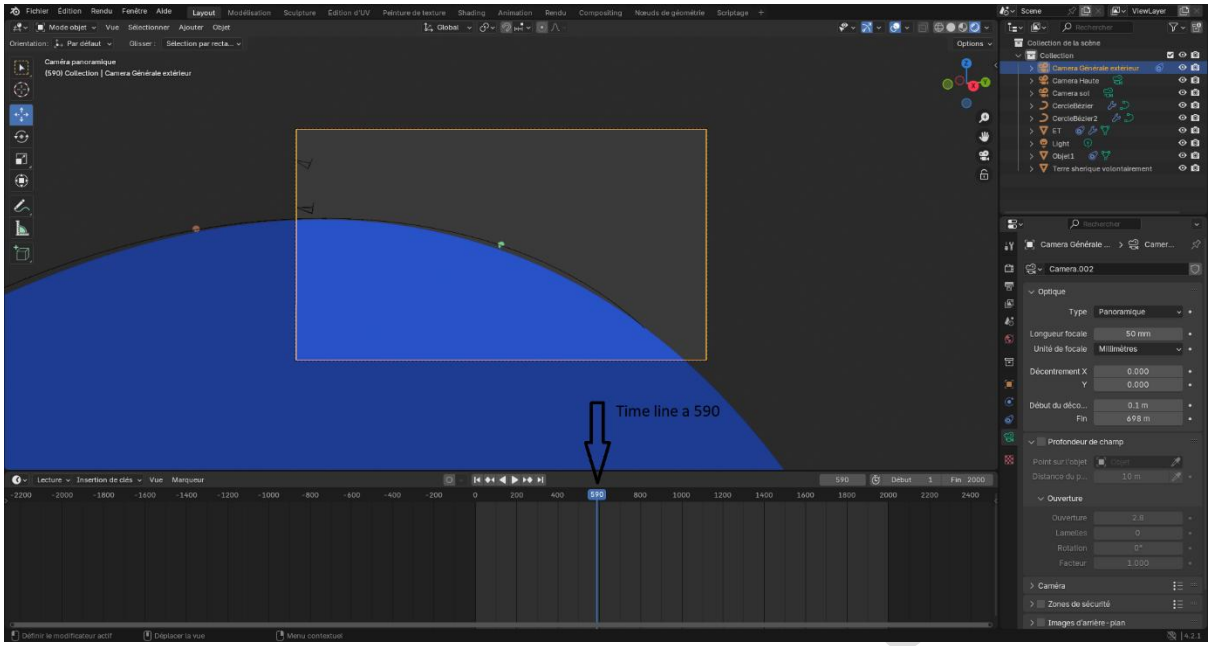


Viewpoint from the ground camera:

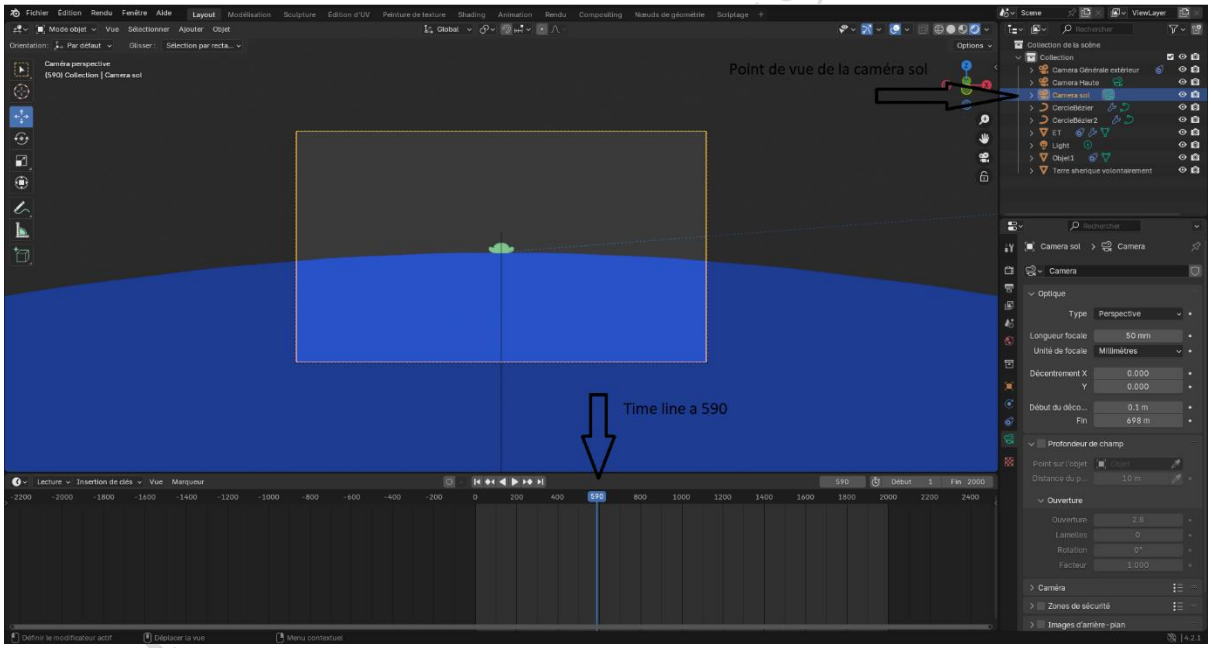


The animation advances to frame #590 from the ground camera and general viewpoint.

General camera viewpoint :

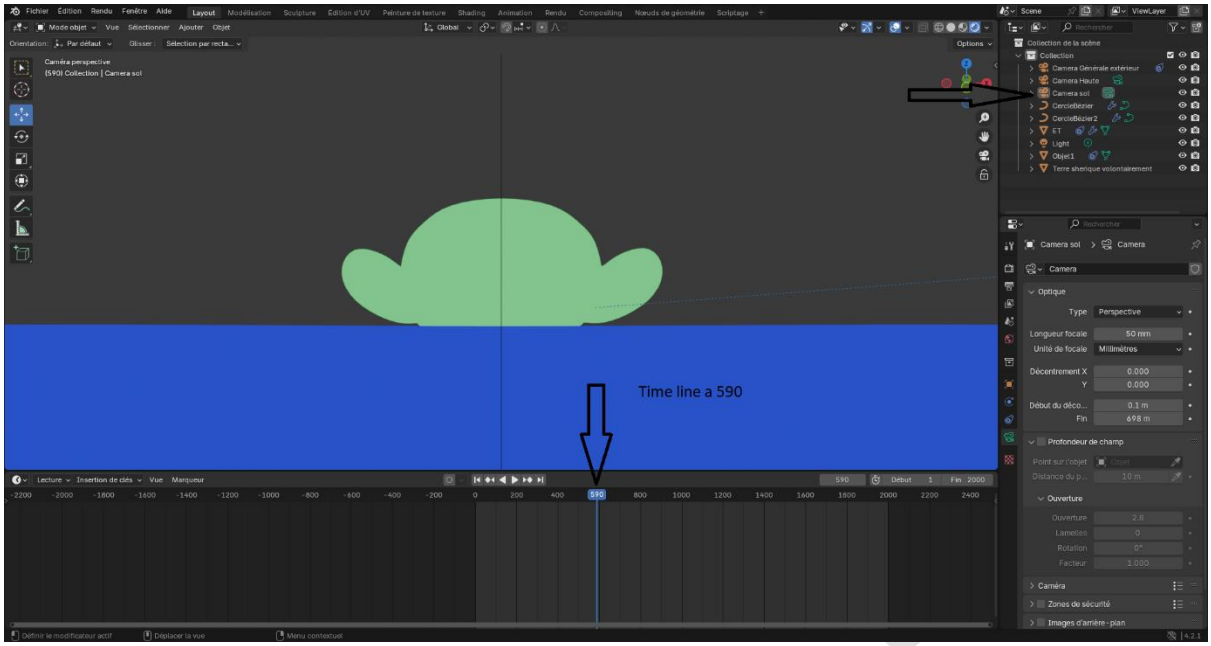


Ground camera viewpoint:



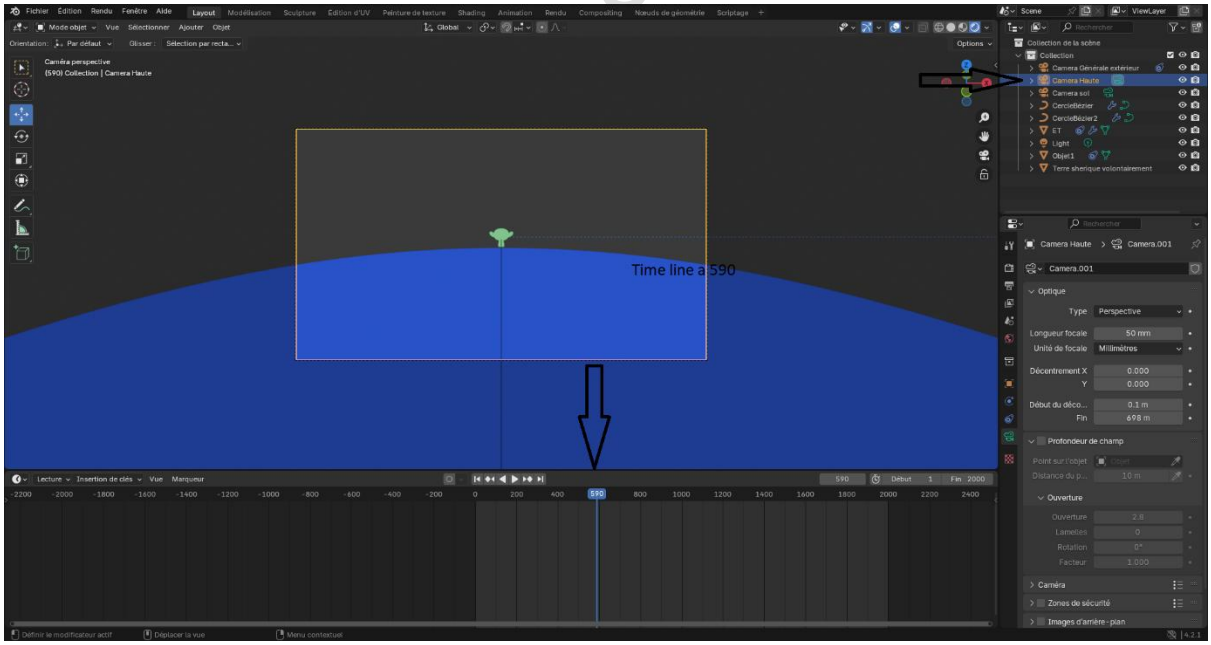
Let's zoom in using the camera option (up wheel when you're in camera mode)!

The ground camera's zoomed-in viewpoint has the same image (frame #590):

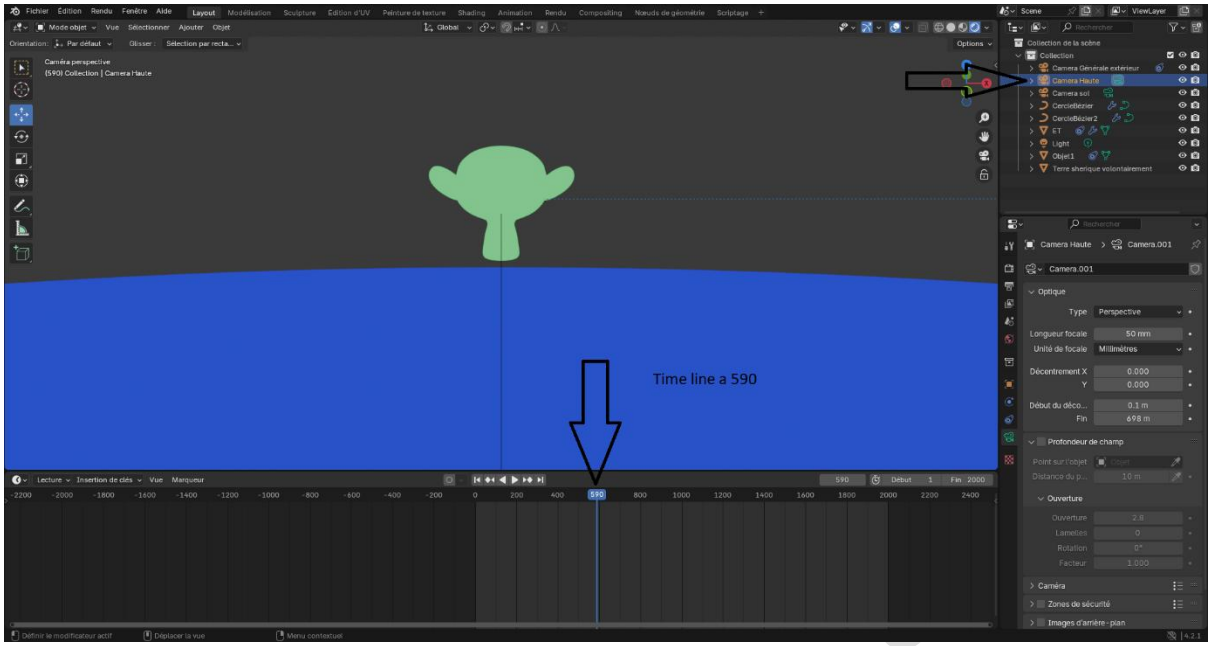


OBSERVATION: We can clearly see that on a spherical model, the object *Suzanne en vert*, which follows the curve of the sphere as it moves away from the observer at ground level, disappears from the bottom. Despite the fact that zooming in improves visibility, the object appears horizontally "cut off."

High camera viewpoint at the same frame (at the same time):



High-angle camera viewpoint (zoomed in):

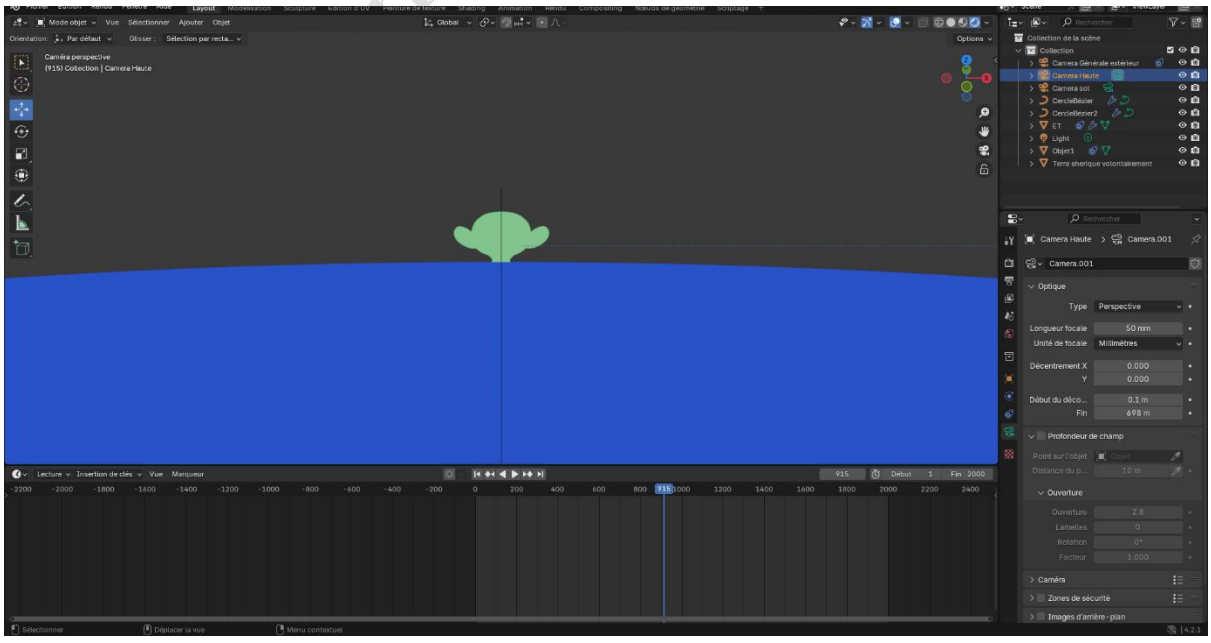


We can see that on a deliberately spherical model at the time when the ground camera viewpoint observes the cited observations, at the time of the high camera shot the *Suzanne vert* object is perfectly visible in its entirety, the zoom allows for better visibility, nothing cuts off the object.

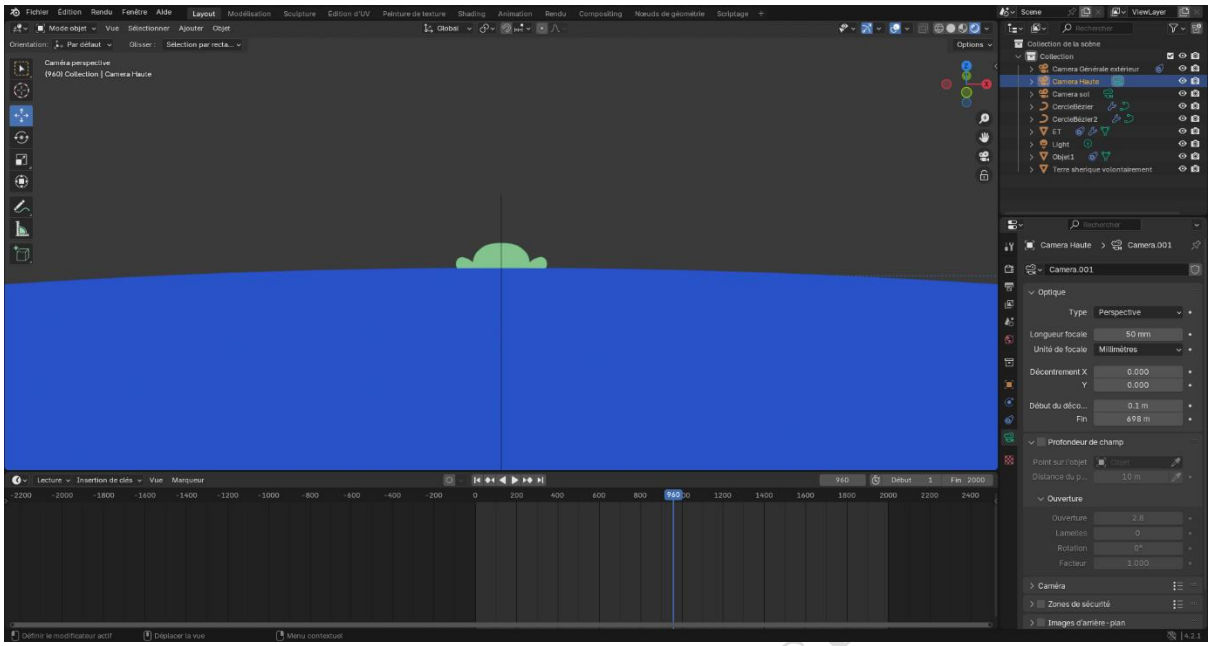
From this model we can conclude that on a sphere, objects moving away from the observer disappear from the lower part; we can predict that the visibility of this object will disappear under the same conditions from the upper camera if we continue the animation.

We can check that!

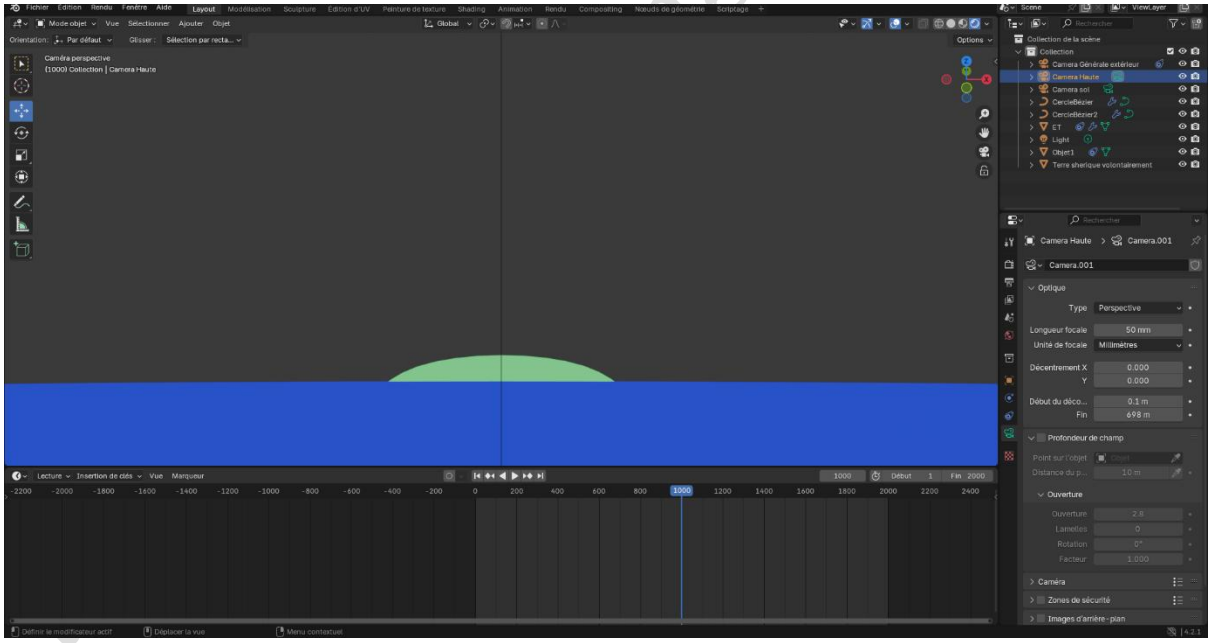
High view point camera at frame #915:



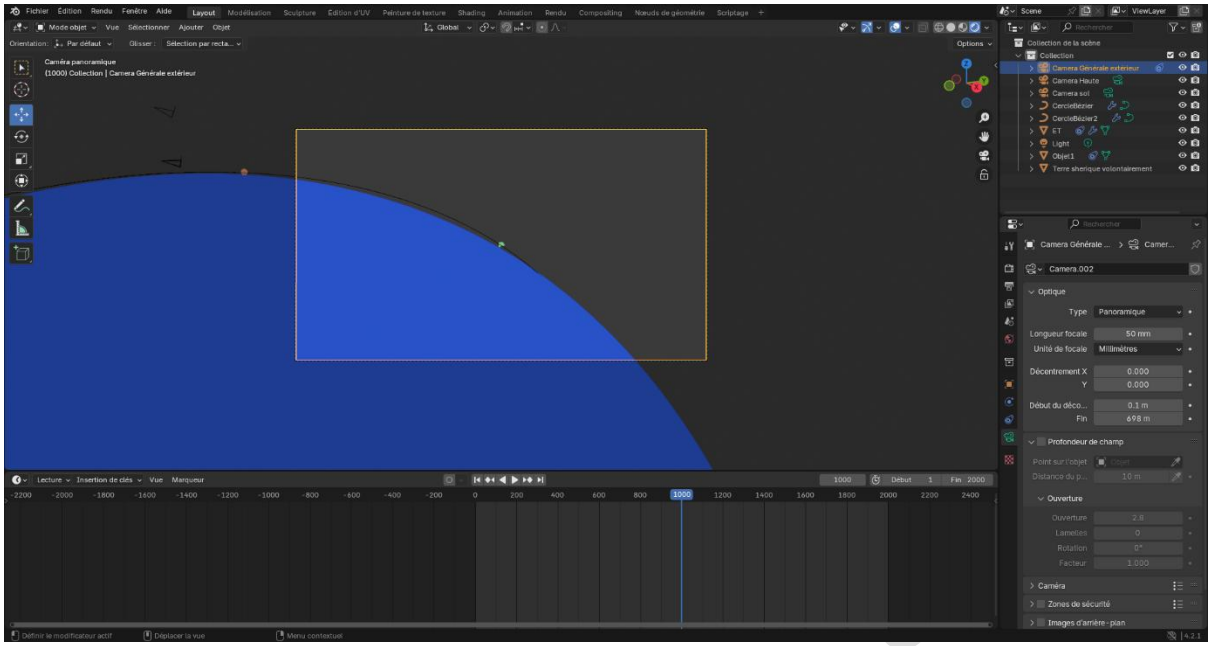
Top-view camera at frame #960:



From the high viewpoint, at frame #1000 and zoomed in, only the upper part of the object *Suzanne vert* can be seen:



State of the scene at frame #1000 from the point of view of the external camera:



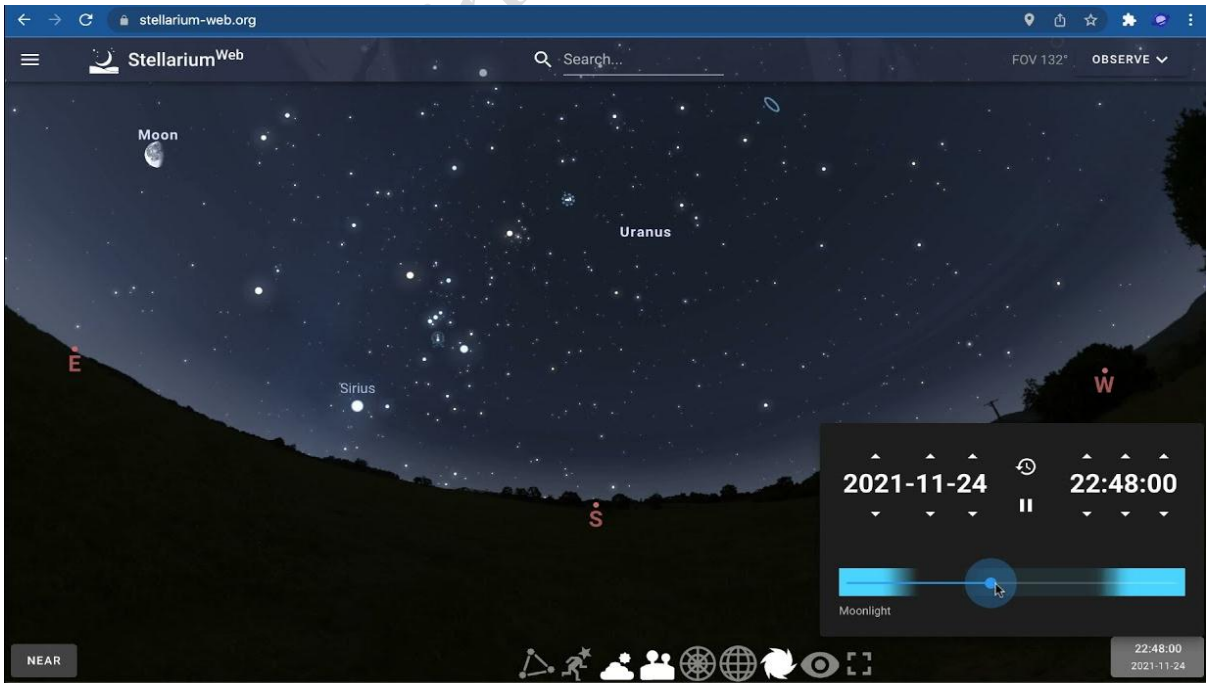
Therefore, after verification, we can affirm through this modeling that if our planet is spherical, we should observe similar behavior in observations made on Earth.

translation into english

(#270) Sky modelization (Stellarium)

Stellarium is free planetarium software, licensed under the GNU GPL, available for GNU/Linux, Microsoft Windows and Mac OS X. It uses OpenGL to display the sky photorealistically in real time. It is thus possible to simulate on a screen what one would actually see with the naked eye, with binoculars or with a small telescope.

https://stellarium.org



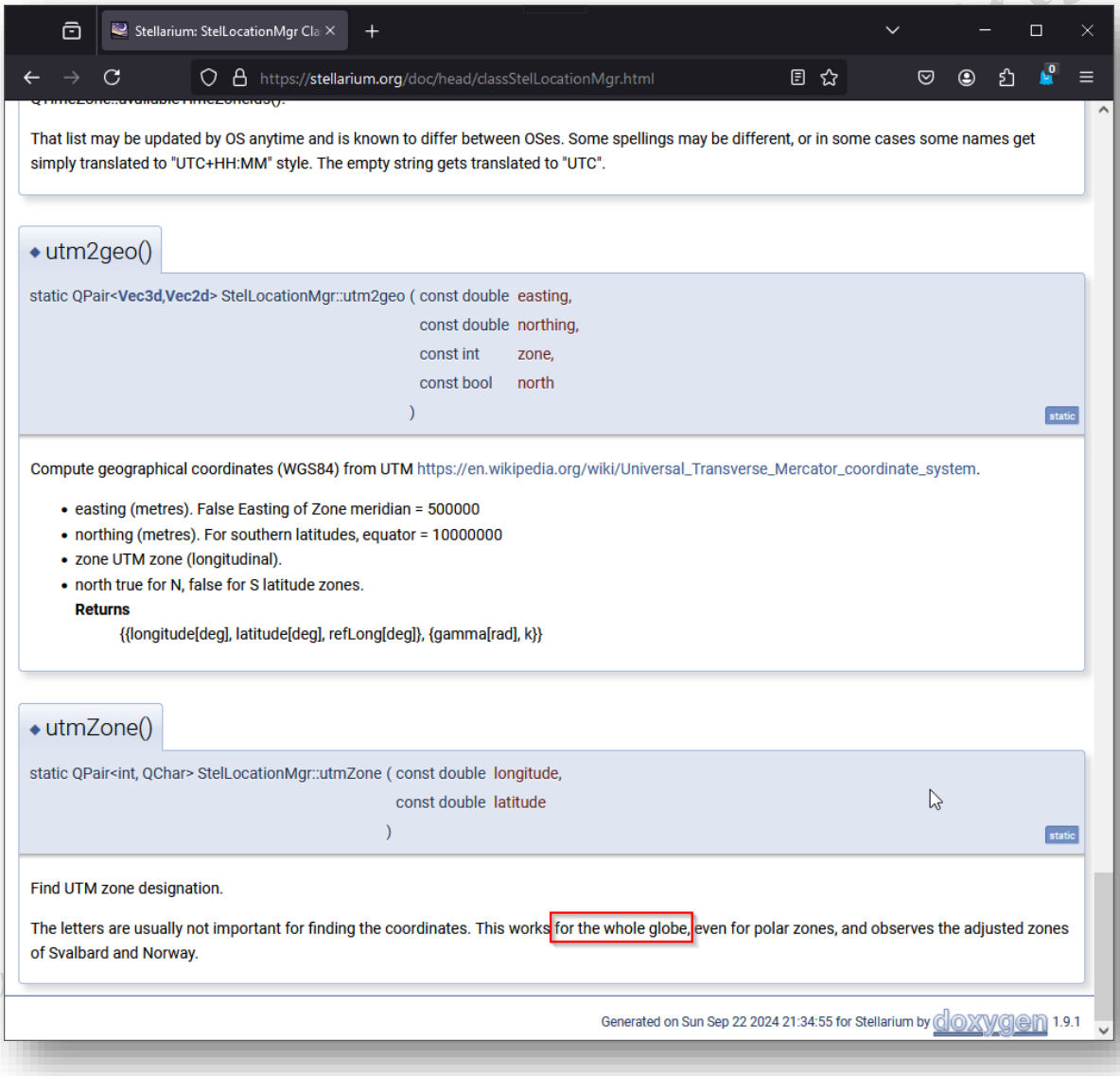
Because some flat-Earthers lie that the latter uses a flat Earth model, we were forced to add this software to this book in order to refute this umpteenth lie irrevocably!

Indeed, Stellarium works so well because it uses the model of reality and not the model of the flat Earth proponents where, for example (among so many others…!) even the observations of the crescent Moon or the shadow of a gnomon would be totally wrong.

Let's see what the online help for the software, available here, says:

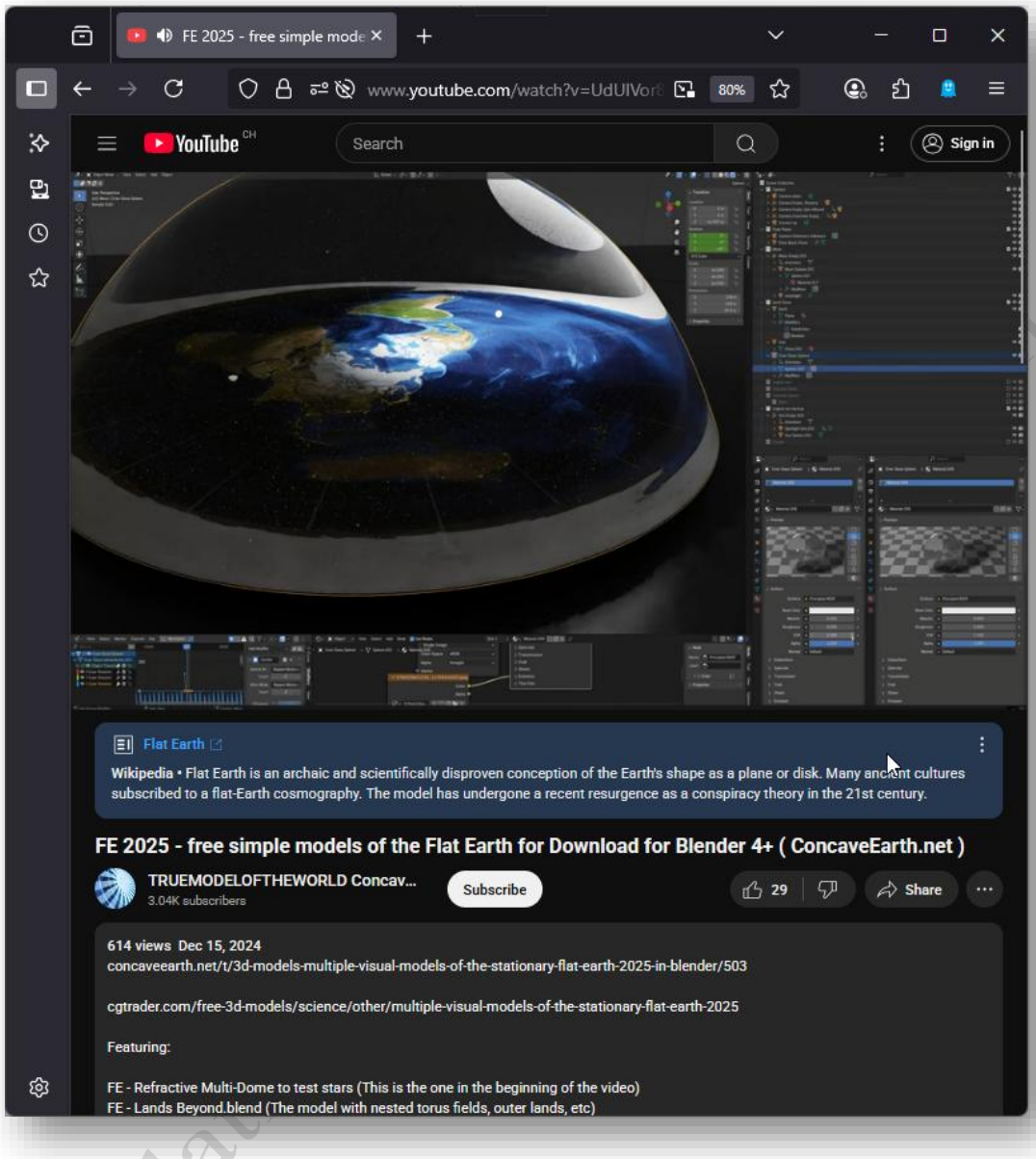
https://stellarium.org/doc/head/classStelLocationMgr.html

So we can clearly see that the globe is mentioned because the model used does indeed use a globe in the software:


Stellarium: StelLocationMgr Cla
https://stellarium.org/doc/head/classStelLocationMgr.html
That list may be updated by OS anytime and is known to differ between OSes. Some spellings may be different, or in some cases some names get simply translated to "UTC+HH:MM" style. The empty string gets translated to "UTC".
utm2geo()
static QPair<Vec3d,Vec2d> StelLocationMgr::utm2geo (const double easting,
const double northing,
const int zone,
const bool north
)
static
Compute geographical coordinates (WGS84) from UTM https://en.wikipedia.org/wiki/Universal_Transverse_Mercator_coordinate_system.
easting (metres). False Easting of Zone meridian = 500000
northing (metres). For southern latitudes, equator = 10000000
zone UTM zone (longitudinal).
north true for N, false for S latitude zones.
Returns
{{longitude[deg], latitude[deg], refLong[deg]}, {gamma[rad], k}}
utmZone()
static QPair<int, QChar> StelLocationMgr::utmZone (const double longitude,
const double latitude
)
static
Find UTM zone designation.
The letters are usually not important for finding the coordinates. This works for the whole globe, even for polar zones, and observes the adjusted zones of Svalbard and Norway.
Generated on Sun Sep 22 2024 21:34:55 for Stellarium by doxygen 1.9.1

Note the existence of the following video in English in which a Blender enthusiast tried everything (according to her own account) to build a flat Earth model that reproduces observable reality but failed (taking into account single or multiple domes, with varying dome refractive indices, etc.). The video is here:

https://www.youtube.com/watch?v=UdUIVor8ngs&t=423s


FE 2025 - free simple mode
www.youtube.com/watch?v=UdUIVor
80%
YouTube CH
Search
Sign in
Flat Earth
Wikipedia • Flat Earth is an archaic and scientifically disproven conception of the Earth's shape as a plane or disk. Many ancient cultures subscribed to a flat-Earth cosmography. The model has undergone a recent resurgence as a conspiracy theory in the 21st century.
FE 2025 - free simple models of the Flat Earth for Download for Blender 4+ (ConcaveEarth.net)
TRUEMODELOFTHEWORLD Concav...
3.04K subscribers
Subscribe
29
Share
614 views Dec 15, 2024
concaveearth.net/t/3d-models-multiple-visual-models-of-the-stationary-flat-earth-2025-in-blender/503
cgtrader.com/free-3d-models/science/other/multiple-visual-models-of-the-stationary-flat-earth-2025
Featuring:
FE - Refractive Multi-Dome to test stars (This is the one in the beginning of the video)
FE - Lands Beyond.blend (The model with nested torus fields, outer lands, etc)

And the Blender source files are available here (note that the file is 630 MB):

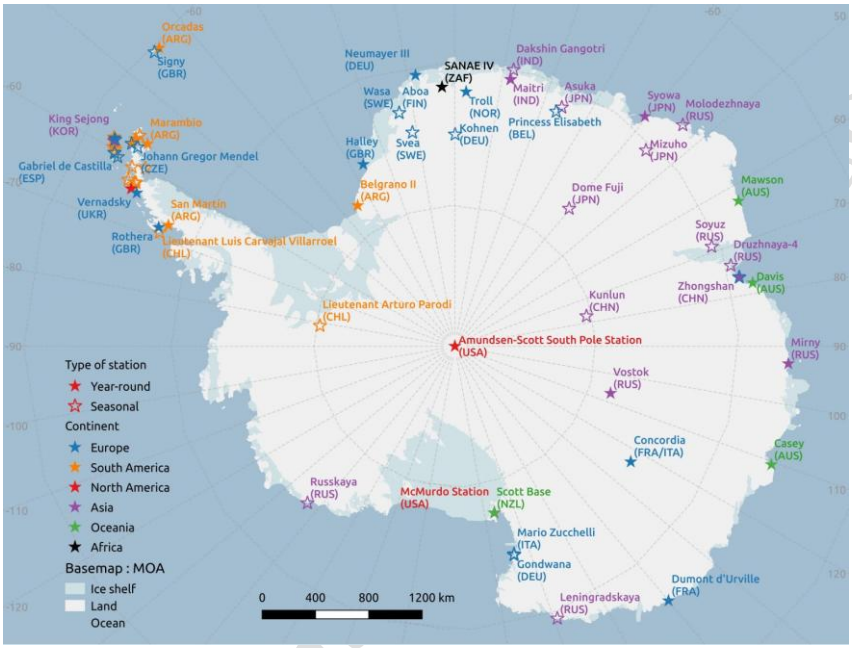
https://www.cgtrader.com/items/5713400/download-page

Antarctica

In the flat Earth hypothesis, the fact that Antarctica is a huge ring surrounding the flat Earth poses several unsolvable problems and issues.

(#271) Distances between scientific stations

The actual distances that scientists travel between research stations (because there are "roads" between some stations) are incompatible with a ring-shaped Antarctica:



The best-known example is the *South Pole Highway*, an ice road in Antarctica that connects the McMurdo coastal station to the Amundsen-Scott South Pole Station. Its construction began in 2003 and was completed in early 2006.

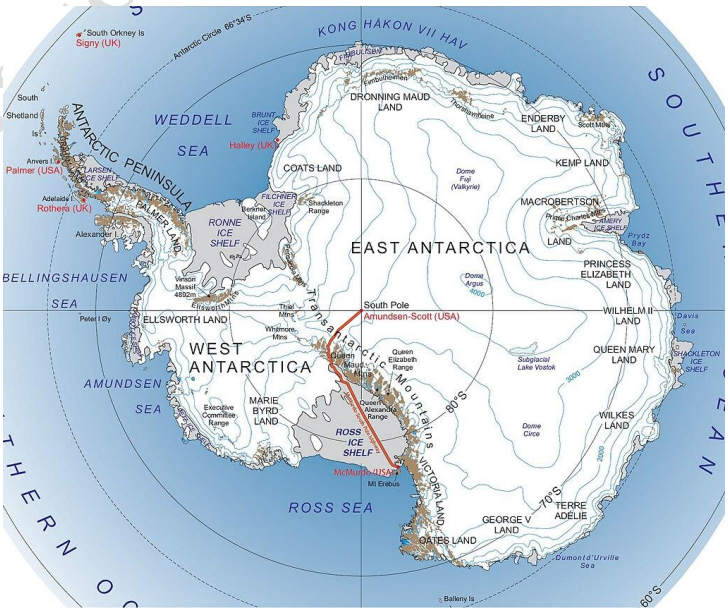


Figure 152 South Pole Highway (source : Wikipedia)

This highway is nearly 1,600 km long. Its construction involved leveling the snow and filling in crevasses. It is not paved, it is made of snow and ice, and is only used during the summer (about a hundred days a year).

Along this route, a fiber optic cable also connects the two stations. This greatly improves communications with the Amundsen-Scott station.

Obviously, there's a problem for our friends from the Flat Earth... In the reality of this world, the highway is 1,600 kilometers long. But in their imaginary and fantastical Flat Earth world, the distance, using the online Flat Earth calculator, would be between McMurdo Station (7°50′47″S 166°40′06″E) and Amundsen-Scott Station (90°S 0°E):

http://walter.bislins.ch/bloge/index.asp?page=Distances+on+Globe+and+Flat+Earth

of… 38,417 kilometers …

Tautonimo

Calculation Form

You can enter Latitude/Longitude in degrees with decimal point (e.g. 54.5°) or degrees, minutes and seconds (e.g. 54° 30min). Latitudes on the Southern Hemisphere and Longitudes westerly of the 0-Meridian must be entered as negative values. See Input Format for Latitude and Longitude for some input examples.

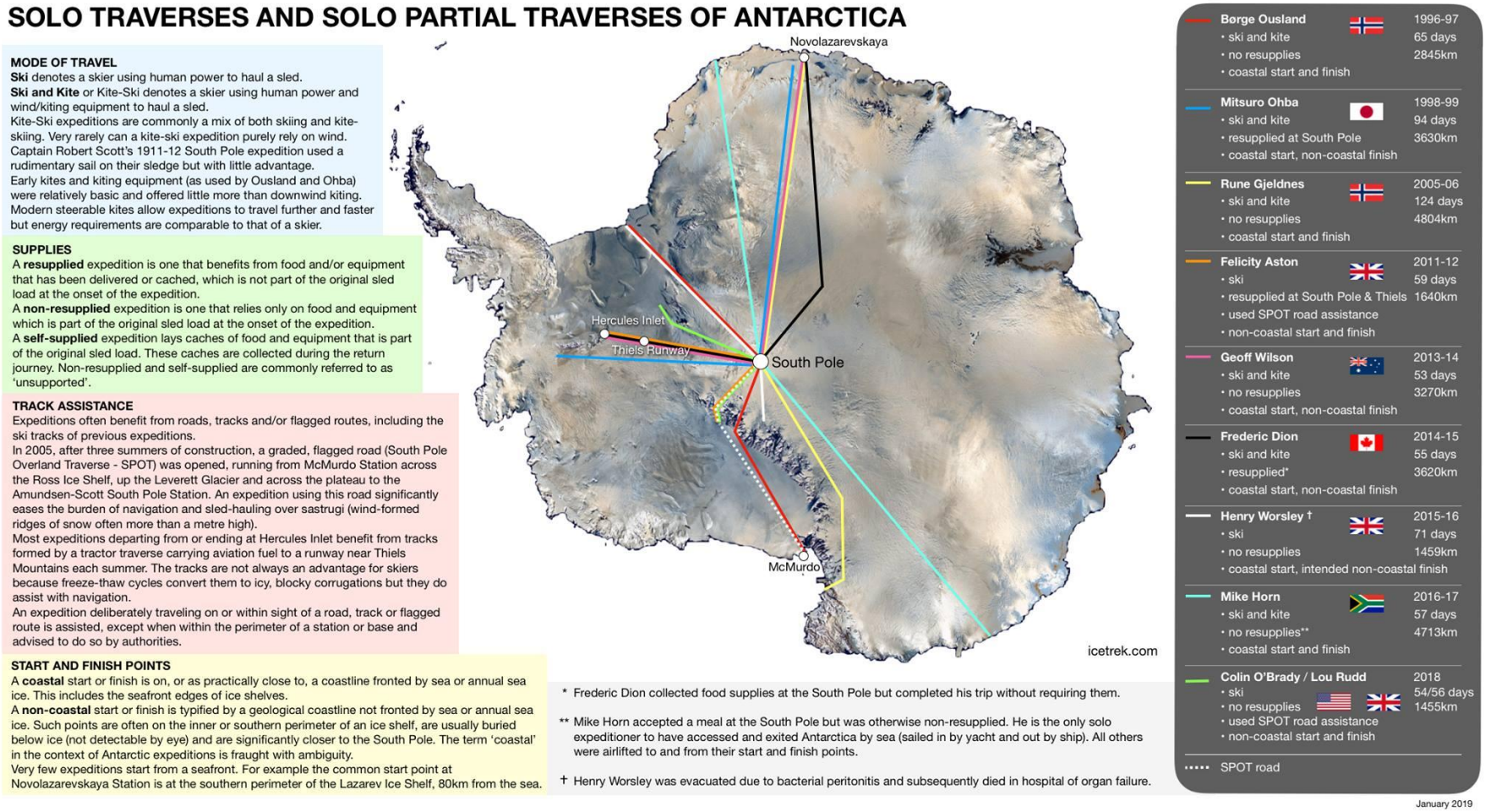
	Latitude			Longitude			→DMS	→Deg	Reset
P1	-77 °	50 min	47 sec	166 °	40 min	6 sec			
P2	-90 °	0 min	0 sec	0 °	0 min	0 sec			

Computed Distances from P1 to P2		Planet Sizes used for Calculation	
Globe	1,351.419896 km	RadiusGlobe	6,371 km
Flat Earth	38,417.607383 km	FE-PoleEquator	10,007.543398 km

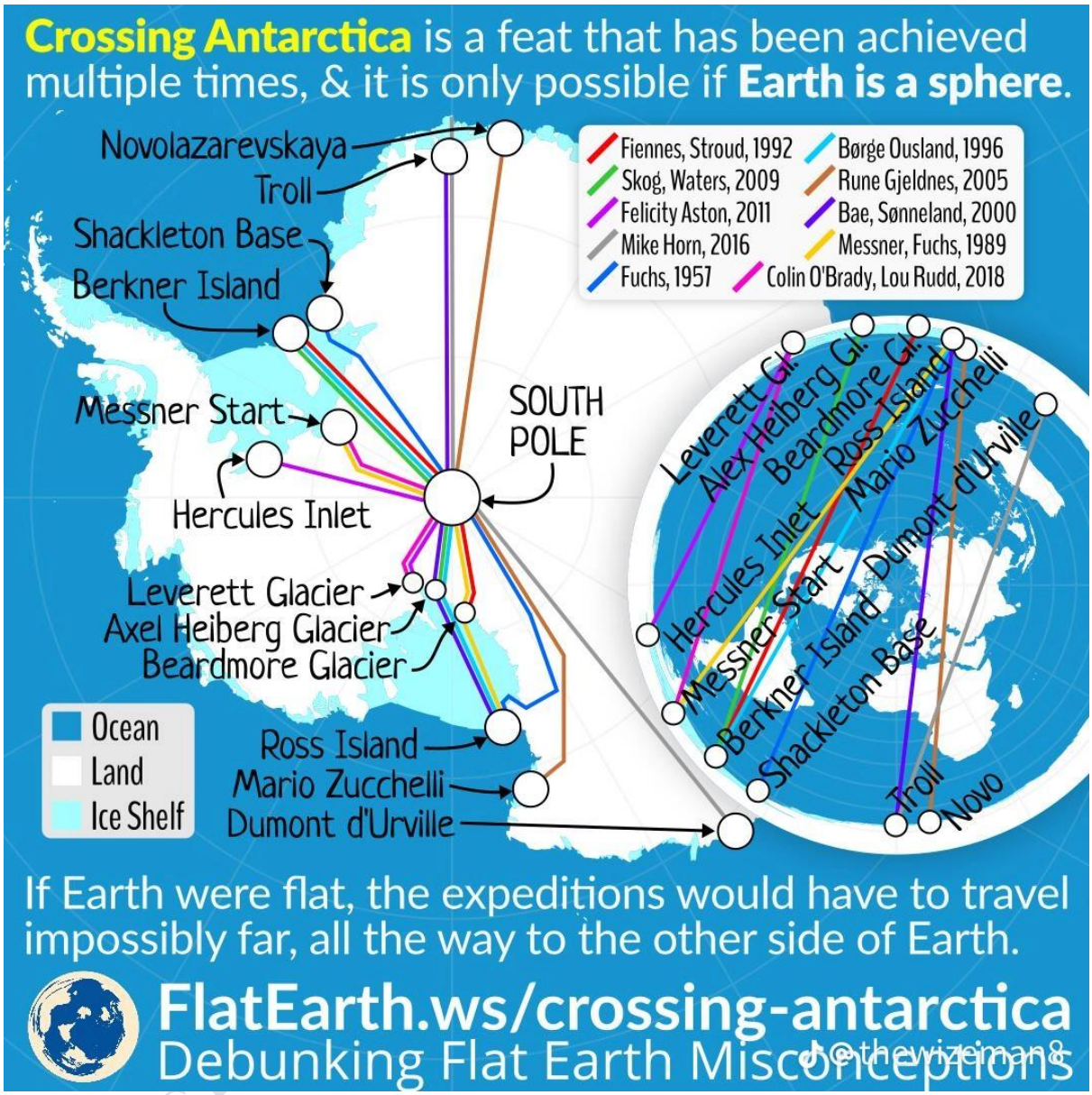
Units ◉ km ○ nmi (nautical miles) ○ mi (statute miles)

(#272-280) Solo crossings of Antarctica, either complete or partial

Several extreme athletes have crossed Antarctica in a time and distance that is completely incompatible with the flat-Earth hypothesis. Since there have been nine crossings incompatible with the flat-Earth hypothesis, that makes nine pieces of evidence against it!


SOLO TRAVERSES AND SOLO PARTIAL TRAVERSES OF ANTARCTICA
MODE OF TRAVEL
Ski denotes a skier using human power to haul a sled.
Ski and Kite or Kite-Ski denotes a skier using human power and wind/kiting equipment to haul a sled.
Kite-Ski expeditions are commonly a mix of both skiing and kite-skiing. Very rarely can a kite-ski expedition purely rely on wind.
Captain Robert Scott's 1911-12 South Pole expedition used a rudimentary sail on their sledge but with little advantage.
Early kites and kiting equipment (as used by Ousland and Ohba) were relatively basic and offered little more than downwind kiting.
Modern steerable kites allow expeditions to travel further and faster but energy requirements are comparable to that of a skier.
SUPPLIES
A resupplied expedition is one that benefits from food and/or equipment that has been delivered or cached, which is not part of the original sled load at the onset of the expedition.
A non-resupplied expedition is one that relies only on food and equipment which is part of the original sled load at the onset of the expedition.
A self-supplied expedition lays caches of food and equipment that is part of the original sled load. These caches are collected during the return journey. Non-resupplied and self-supplied are commonly referred to as 'unsupported'.
TRACK ASSISTANCE
Expeditions often benefit from roads, tracks and/or flagged routes, including the ski tracks of previous expeditions.
In 2005, after three summers of construction, a graded, flagged road (South Pole Overland Traverse - SPOT) was opened, running from McMurdo Station across the Ross Ice Shelf, up the Leverett Glacier and across the plateau to the Amundsen-Scott South Pole Station. An expedition using this road significantly eases the burden of navigation and sled-hauling over sastrugi (wind-formed ridges of snow often more than a metre high).
Most expeditions departing from or ending at Hercules Inlet benefit from tracks formed by a tractor traverse carrying aviation fuel to a runway near Thiels Mountains each summer. The tracks are not always an advantage for skiers because freeze-thaw cycles convert them to icy, blocky corrugations but they do assist with navigation.
An expedition deliberately traveling on or within sight of a road, track or flagged route is assisted, except when within the perimeter of a station or base and advised to do so by authorities.
START AND FINISH POINTS
A coastal start or finish is on, or as practically close to, a coastline fronted by sea or annual sea ice. This includes the seafront edges of ice shelves.
A non-coastal start or finish is typified by a geological coastline not fronted by sea or annual sea ice. Such points are often on the inner or southern perimeter of an ice shelf, are usually buried below ice (not detectable by eye) and are significantly closer to the South Pole. The term 'coastal' in the context of Antarctic expeditions is fraught with ambiguity.
Very few expeditions start from a seafront. For example the common start point at Novolazarevskaya Station is at the southern perimeter of the Lazarev Ice Shelf, 80km from the sea.
Novolazarevskaya
Hercules Inlet
Thiels Runway
South Pole
McMurdo
icetrek.com
* Frederic Dion collected food supplies at the South Pole but completed his trip without requiring them.
** Mike Horn accepted a meal at the South Pole but was otherwise non-resupplied. He is the only solo expeditioner to have accessed and exited Antarctica by sea (sailed in by yacht and out by ship). All others were airlifted to and from their start and finish points.
† Henry Worsley was evacuated due to bacterial peritonitis and subsequently died in hospital of organ failure.
Borge Ousland 1996-97
• ski and kite 65 days
• no resupplies 2845km
• coastal start and finish
Mitsuro Ohba 1998-99
• ski and kite 94 days
• resupplied at South Pole 3630km
• coastal start, non-coastal finish
Rune Gjeldnes 2005-06
• ski and kite 124 days
• no resupplies 4804km
• coastal start and finish
Felicity Aston 2011-12
• ski 59 days
• resupplied at South Pole & Thiels 1640km
• used SPOT road assistance
• non-coastal start and finish
Geoff Wilson 2013-14
• ski and kite 53 days
• no resupplies 3270km
• coastal start, non-coastal finish
Frederic Dion 2014-15
• ski and kite 55 days
• resupplied* 3620km
• coastal start, non-coastal finish
Henry Worsley † 2015-16
• ski 71 days
• no resupplies 1459km
• coastal start, intended non-coastal finish
Mike Horn 2016-17
• ski and kite 57 days
• no resupplies** 4713km
• coastal start and finish
Colin O'Brady / Lou Rudd 2018
• ski 54/56 days
• no resupplies 1455km
• used SPOT road assistance
• non-coastal start and finish
SPOT road
January 2019

To compare this to the flat Earth…::

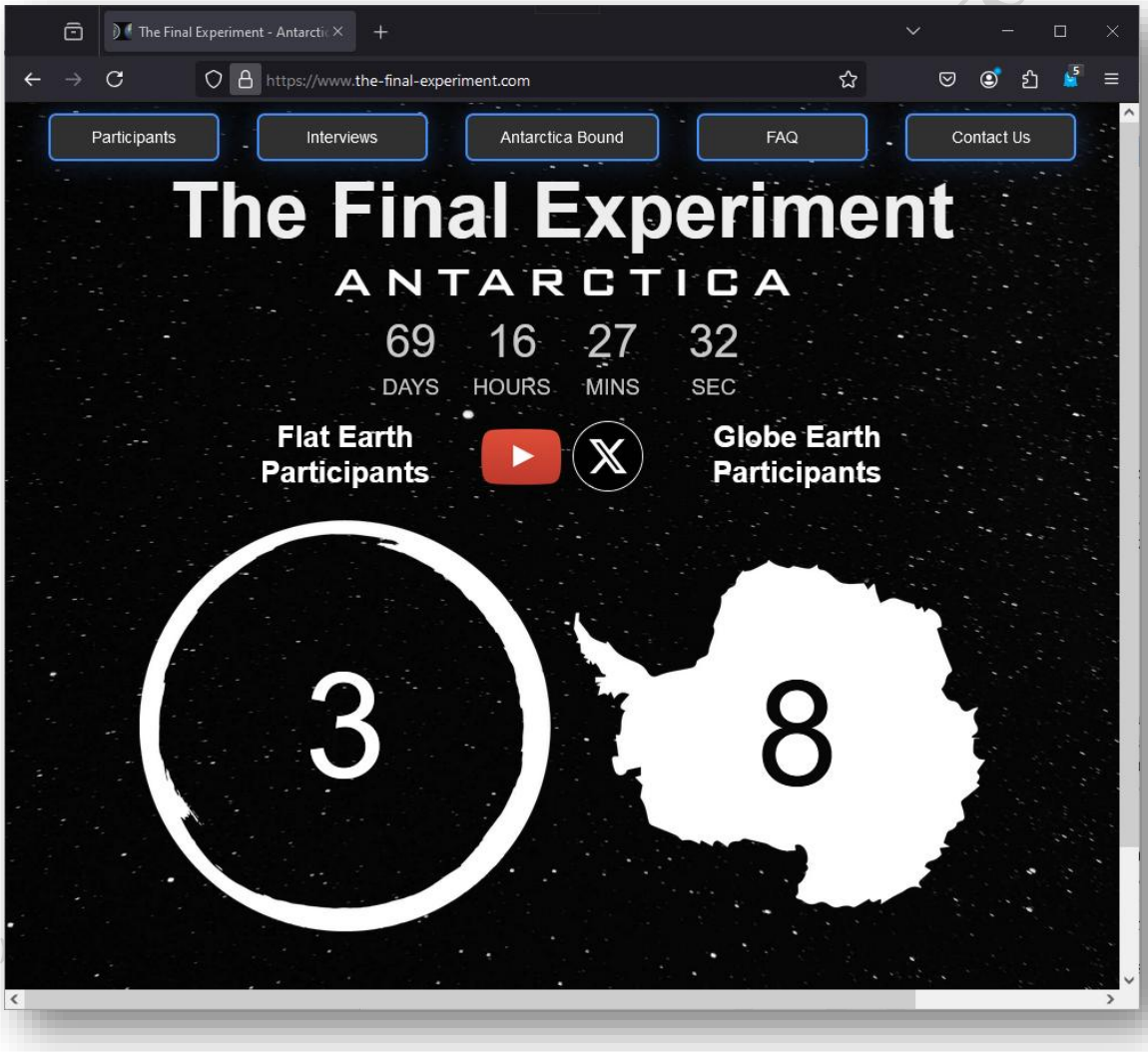


Once again… everything has been said!

(#281) The Final Experiment (Antarctica)

The Final Experiment in Antarctica is an initiative to resolve the debate between the flat Earth hypothesis and spherical Earth scientific theory. The experiment involves sending proponents of both the flat Earth hypothesis and spherical Earth scientific theory to Antarctica to observe whether the Sun is visible 24 hours a day (which is impossible according to the flat Earth hypothesis, regardless of the time of year, since Antarctica is a giant ring in the flat Earth hypothesis!), a phenomenon that can only occur on a spherical Earth. This experiment, designed to provide conclusive evidence about the shape of the Earth by directly observing the Sun's behavior in Antarctica, took place on Sunday, December 15, 2024.

https://www.the-final-experiment.com



For flat Earth proponents, a 24-hour Sun in Antarctica is impossible because their model does not allow for such an occurrence. In their fanciful flat-Earth pseudo-model, the Sun moves in a circle above the Earth's surface, illuminating different areas at different times. This hypothesis does not allow the Sun to remain visible for 24 consecutive hours at a fixed location like Antarctica.

In contrast, on a spherical Earth, the tilt of the Earth's axis and its rotation allow the Sun to remain above the horizon for 24 consecutive hours in the polar regions during the summer and winter solstices. This is the phenomenon observed in Antarctica and the Arctic, and it is incompatible with the flat Earth hypothesis.

The day we are writing these lines is December 15, 2024, and indeed the Sun is at midnight, which proves once again that the flat Earth is imaginary and that the defenders of the flat Earth are mythomaniacs or just ignorants:

https://www.youtube.com/watch?v=d_LNSbStu9c

There are already many videos of a 24-hour sun in Antarctica available on YouTube:

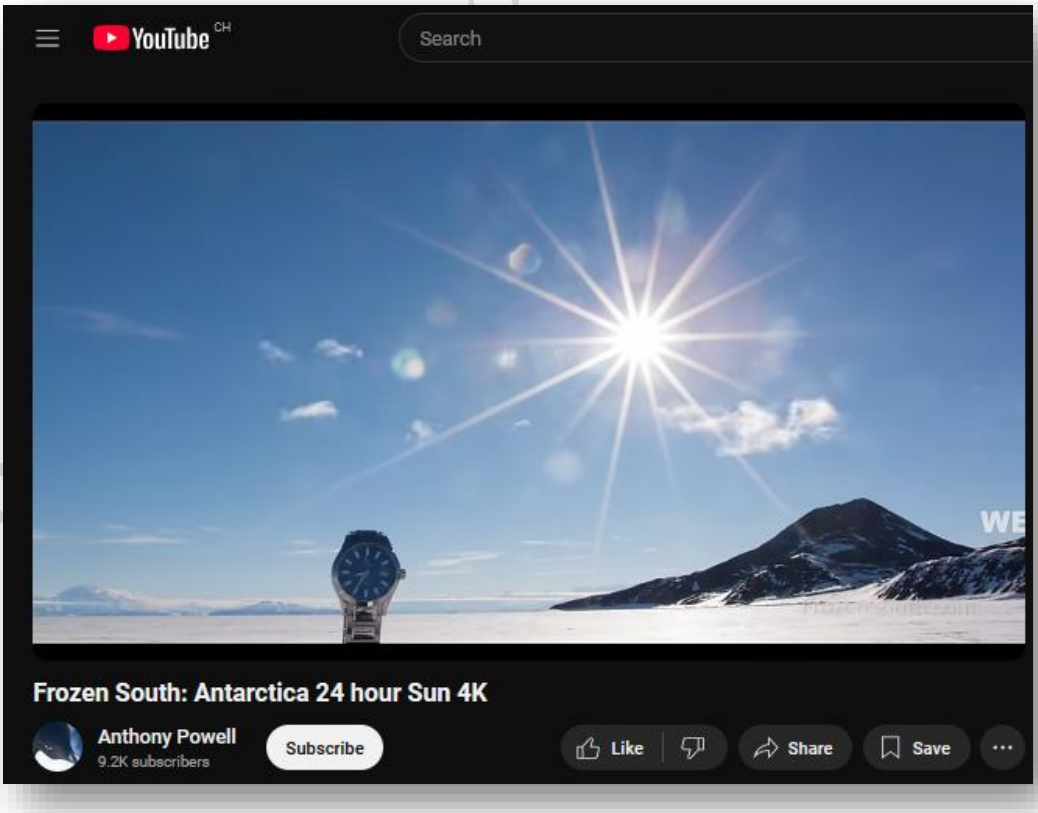
The British doctor Eoin Macdonald-Nethercott worked at the ESA's Concordia research station in Antarctica (European Space Agency). It was there that he took and assembled the sequence of images above, which shows a sunrise and sunset in Antarctica.

The original photo above can be found here:

https://www.flickr.com/photos/petapixel/24127832262/sizes/o/

There are several videos available on YouTube that recorded this, such as:

https://www.youtube.com/watch?v=BgZa9oZDN5g

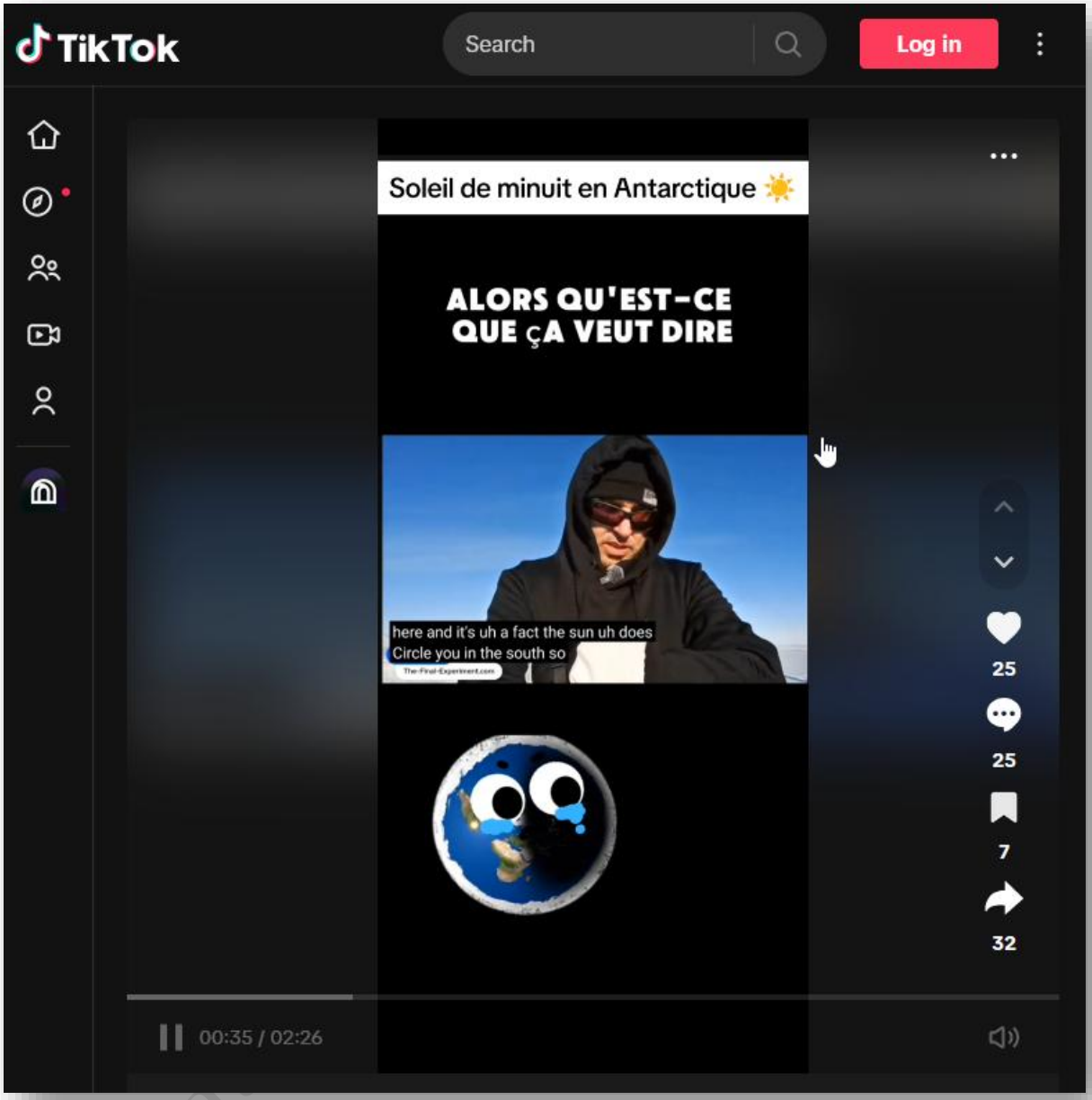


Note that all the leading flat-Earthers in the United States (who, incidentally, rely on this as their sole source of income… i.e. are grifters) refused this invitation to go to Antarctica, even though all their travel expenses and lost earnings were reimbursed. Curious for people who claim to be seeking the truth…

Here is the list of those who refused the all-expenses paid trip (ask yourself why…):

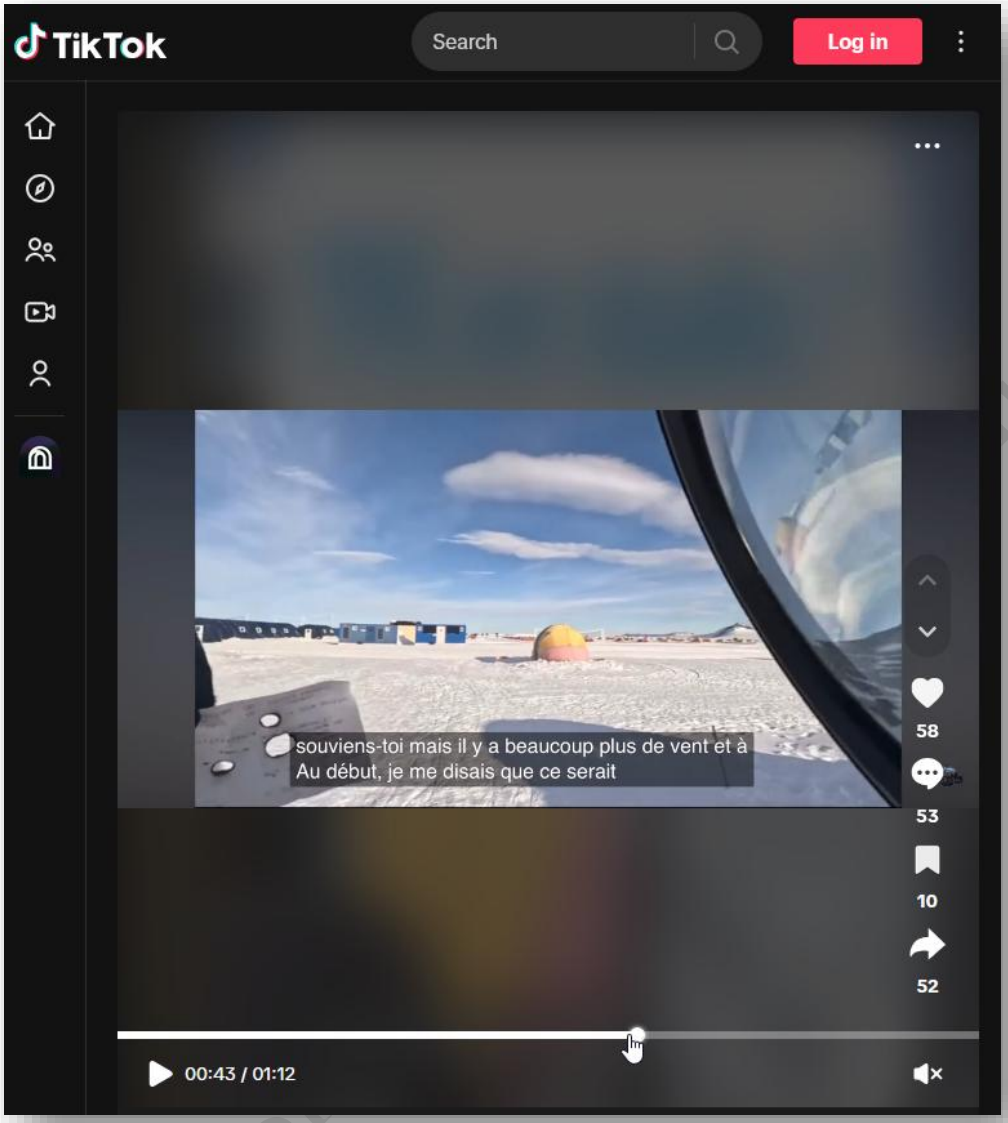
On Sunday, December 15, 2024, the American christian flat-Earther and YouTuber Jaron Campanella of the YouTube channel *Jeranism* (163,000 followers at the time we write these lines) admitted live from Antarctica that he was wrong and that the Earth is indeed a globe:

https://www.tiktok.com/@gloglo_records/video/7448572325152181526?_r=1&_t=8sEgcx7x1xG

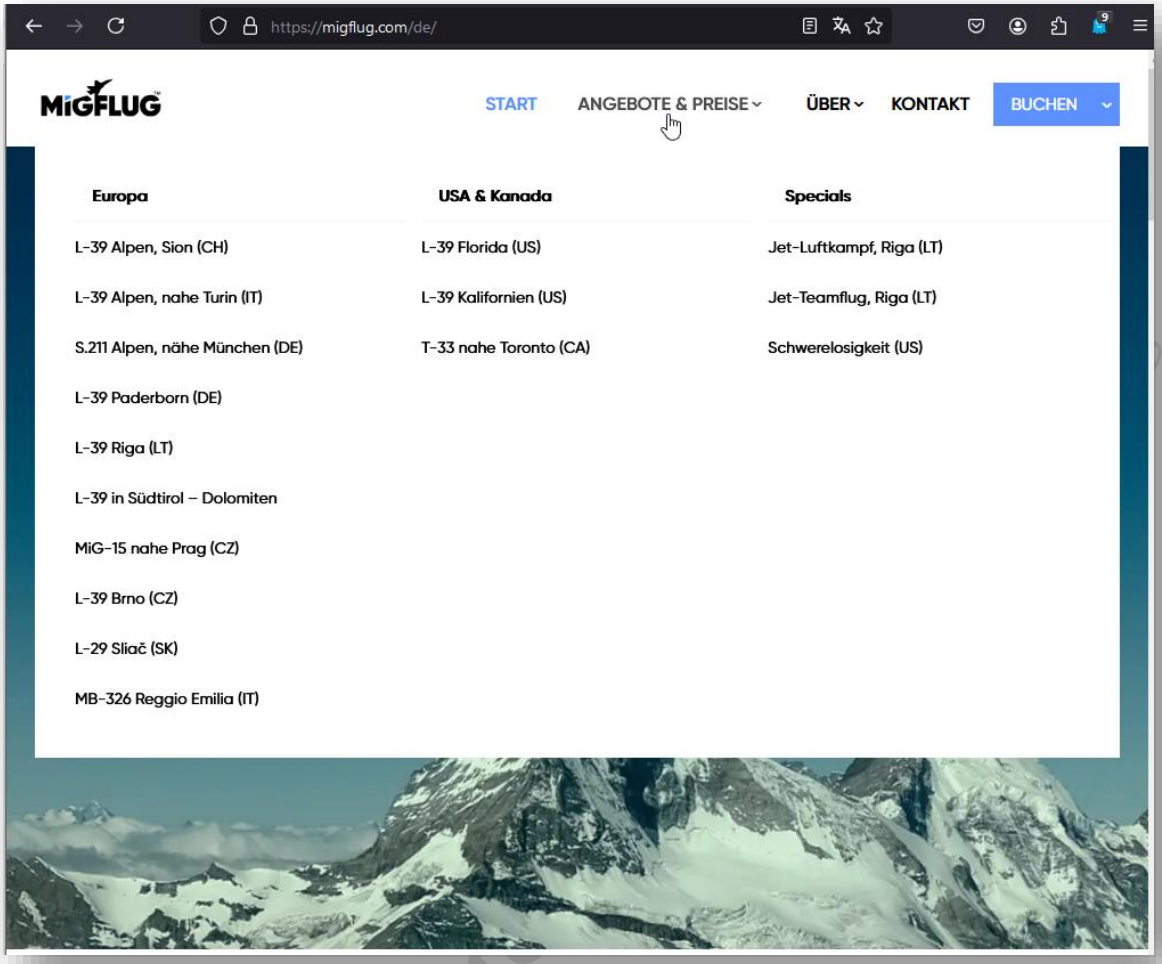


Some flattards in total cognitive dissonance have therefore claimed that the members of the Final Experiment who went to Antarctica were in a giant American studio, but the following video made by the ex-flattard Jeran, who was there with a magnifying glass, proves the contrary:

https://vm.tiktok.com/ZNewmYjrh



Notice anecdotally that the company MiGFlug™ offers priced flights in military aircraft for private individuals:



Offered to all the flattards to refund them for the flight if they did not see the curvature of the Earth by boarding a MiG-29 Fulcrum (which goes at an altitude of 20-22 kilometers). And guess what oddly enough… that never happened…!

translation int

MiGFlug
83.7K subscribers

SUBSCRIBE

Published on Nov 17, 2017

- We repeatedly offered flights to Flat Earthers who commented under our videos, offering them a full refund if they dare to book an Edge of Space flight with us and don't see the curvature up there. Not a single one of them accepted the offer, which suggests they are not that sure about their Flat Earth theory in the end.

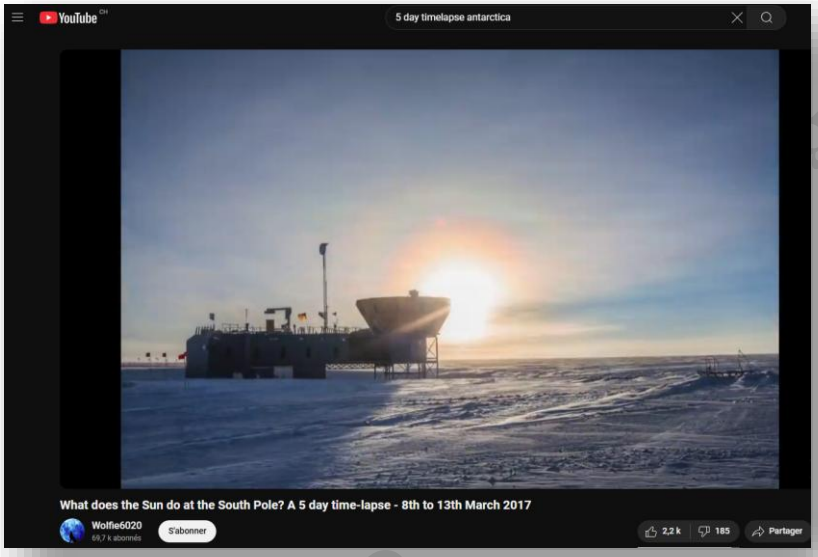
translation into

Midnight Sun

We have already dealt with the midnight Sun problem on page 337 (which is why its presence here is not numbered as "proof").

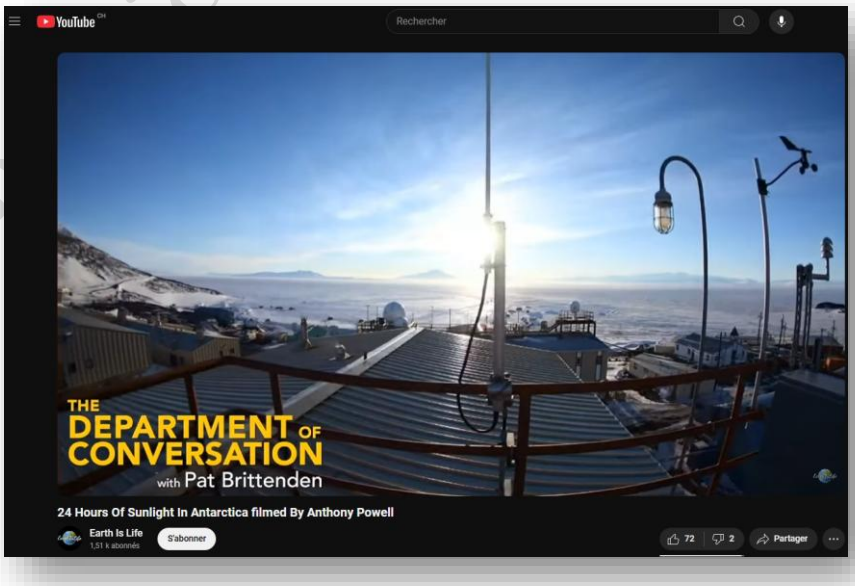
But just for fun, here's a link to a nice YouTube video (note that in all the videos the Sun moves from right to left as you would expect on a globe Earth, and this also contradicts the flat Earth theory!):

https://www.youtube.com/watch?v=4av1CD8smII

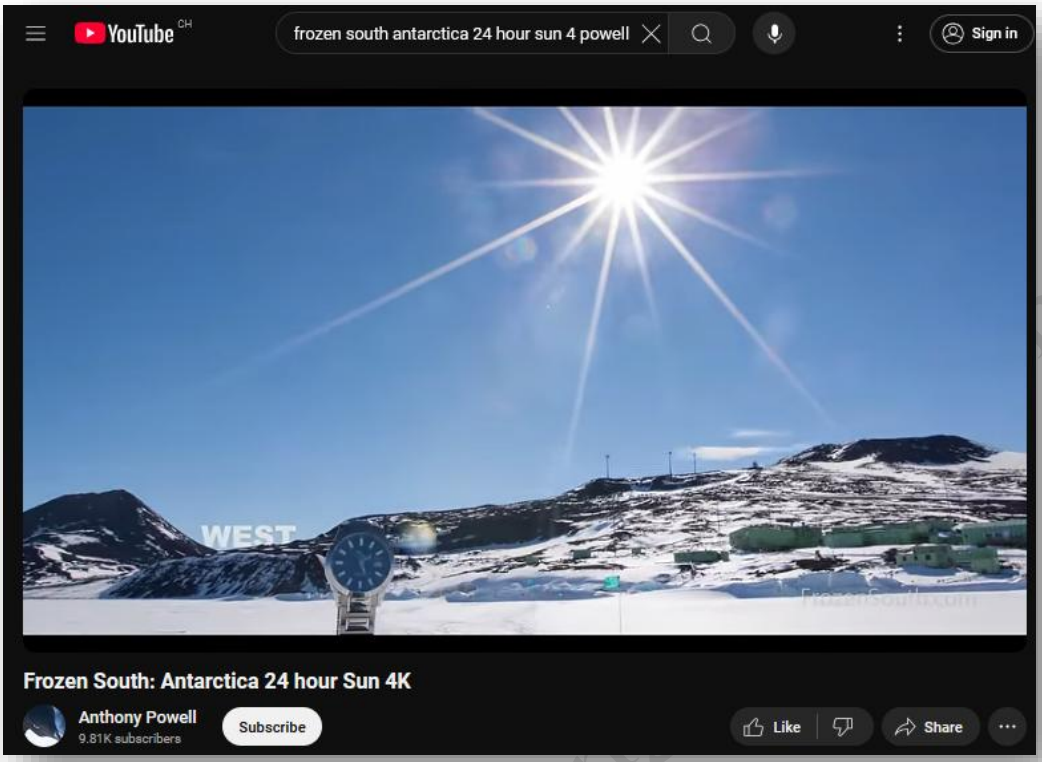


Or another one:

https://youtu.be/GxqTglEVkAU?si=_GZPQFcOCO26LutL

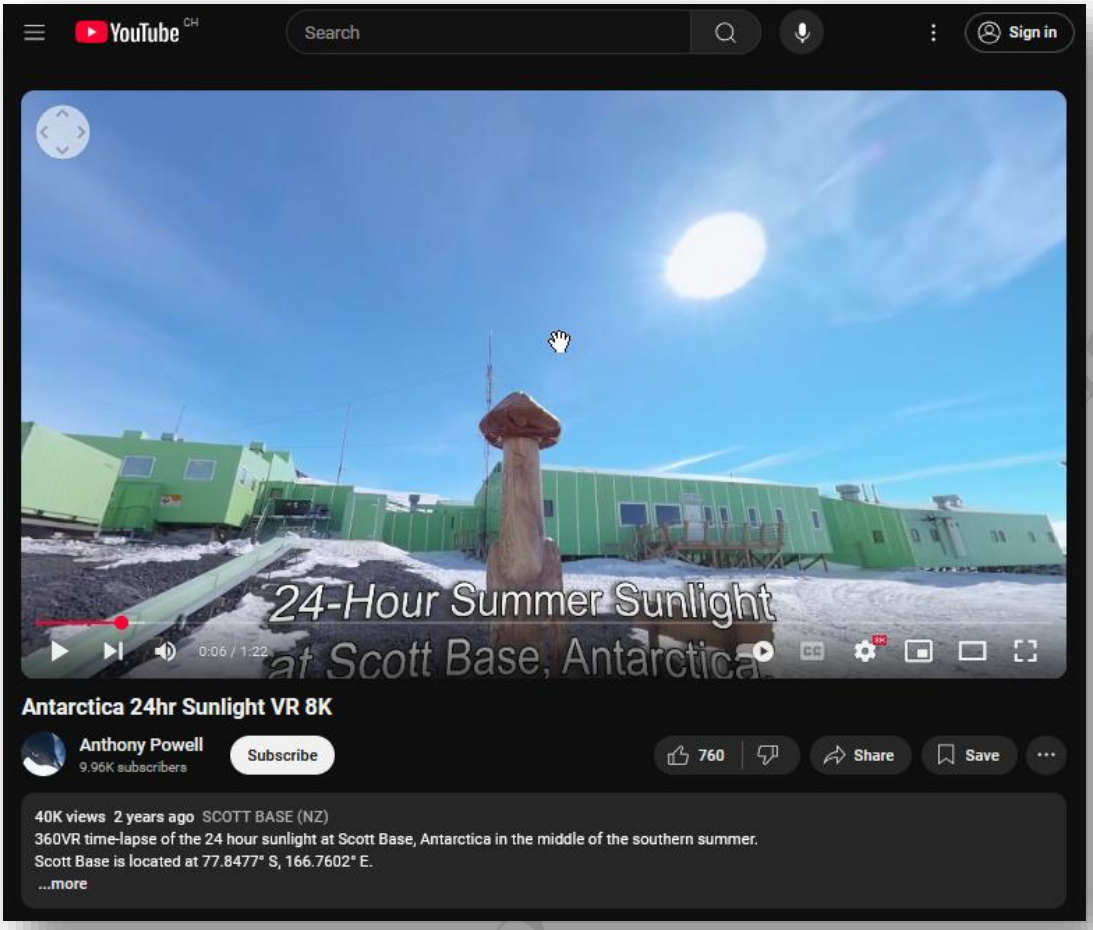


Or another one:



This last video being made with the following installation (note that we see the watch there…):

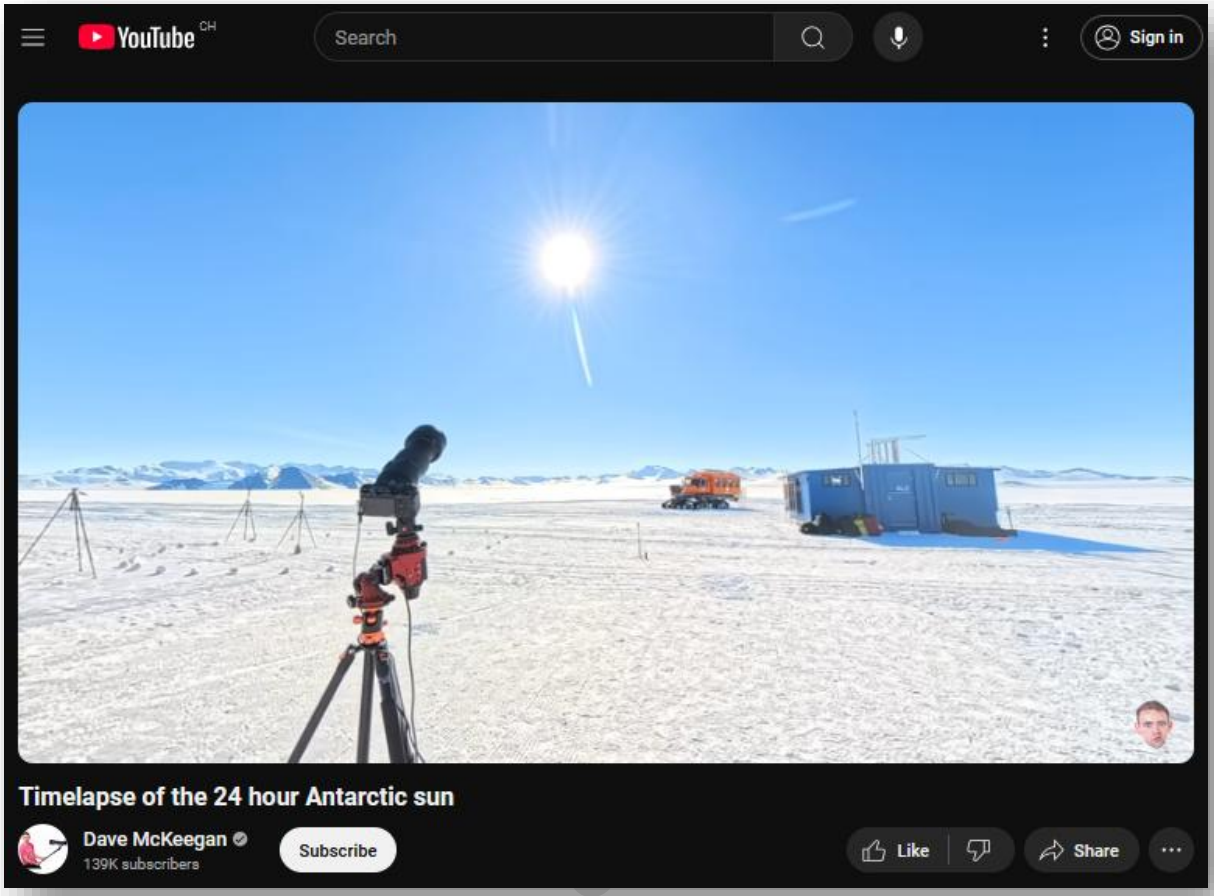
Or here in 8K for people who own an augmented reality headset:



Or the time lapse of more than 25 hours in Antarctica on December 17, 2024 of the famous Final Experiment (at Union Glacier 79°45'0.00"S, 82°30'0.00"W) which forever debunks the lies of flurfers:

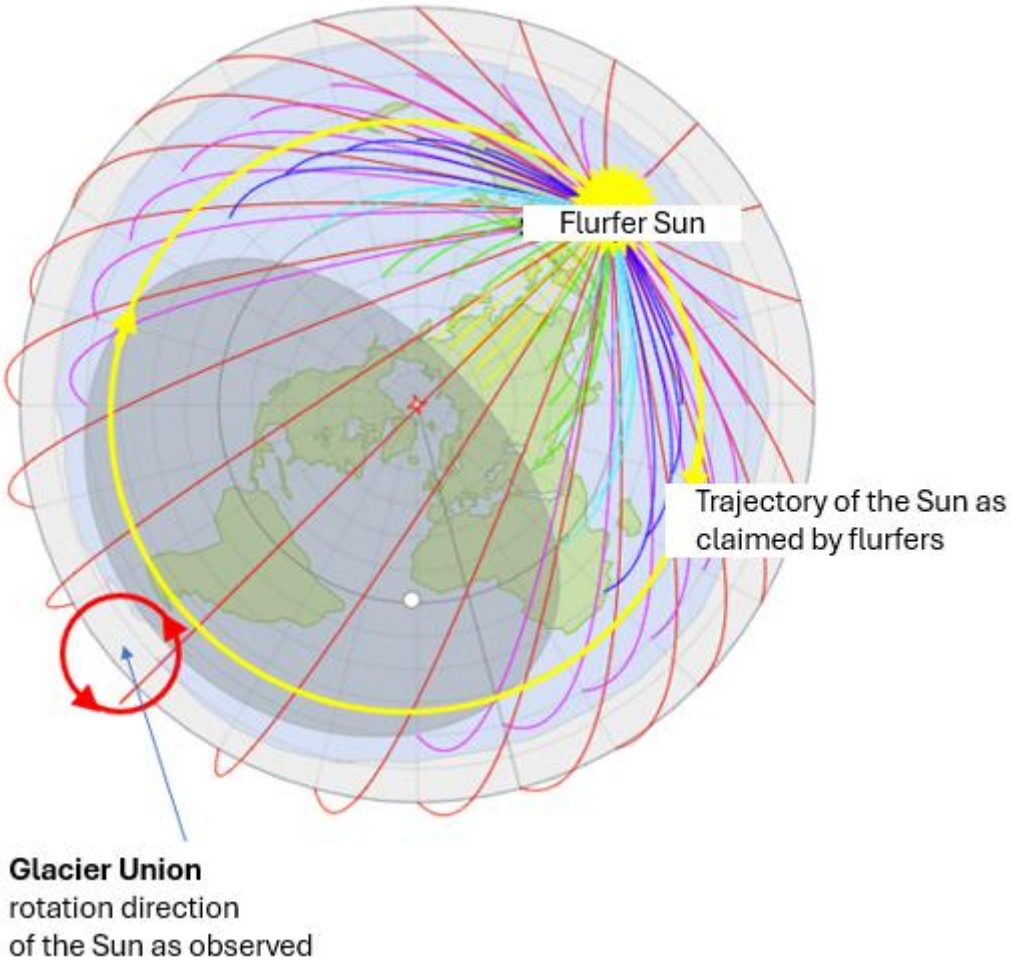
https://www.youtube.com/watch?v=in0B1OQG3-M

translation into



As the illustration below of the experiment above shows… nothing works if we consider the Earth to be flat!:

translation into



The Midnight Sun occurs because the Earth is a rotating sphere and its axis of rotation is tilted. The flat Earth hypothesis fails to explain why the Midnight Sun occurs over both the north and south polar regions and moves in opposite directions.

It must be also well understood the impossibility that this implies: We should not observe the Sun from Antarctica in the direction of the magnetic/geographic South because, according to flat scientists, the Sun should ALWAYS be in the direction of the magnetic/geographic North!

Sports competitions

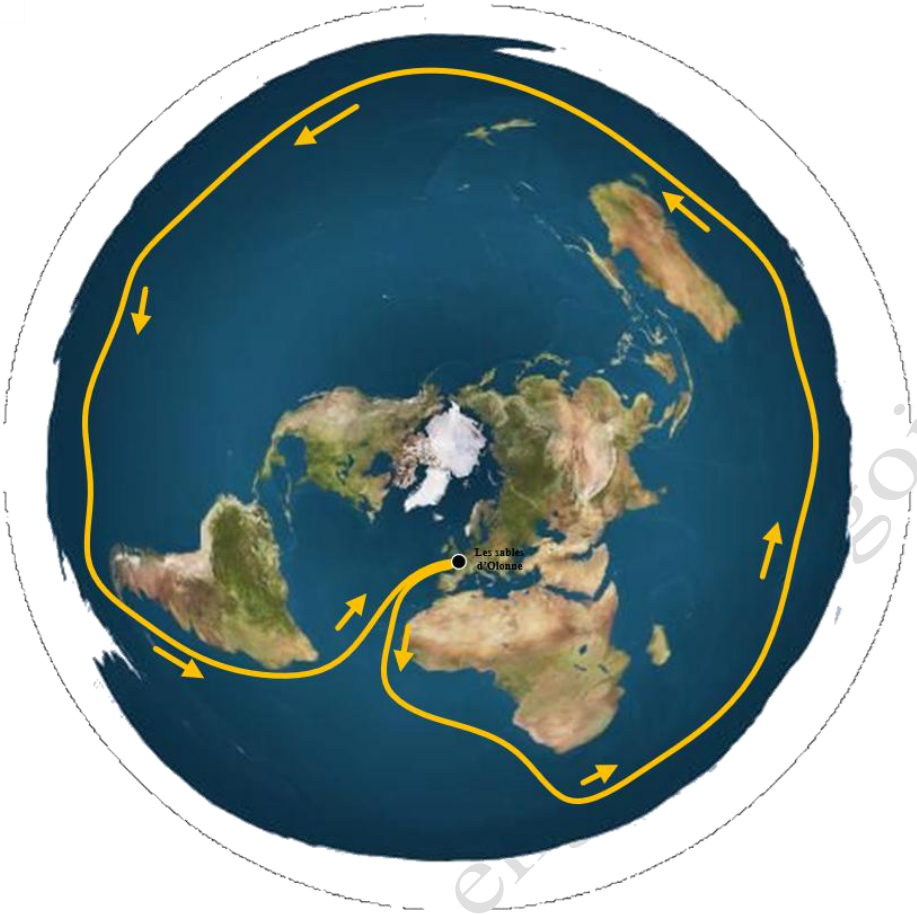
The existence of several sporting competitions makes the flat Earth hypothesis impossible (yes, again…) and particularly because of the time-distance value used by the competitors.

Let us see that!

(#282) Vendée Globe

The Vendée Globe (even the name itself… "Globe," not "Flat Vendée") takes place every four years: the 10th edition was held in November 2024, and previous editions were held in 1989, 1992, 1996, 2000, 2004, 2008, 2012, 2016, and 2020. It starts in Les Sables-d'Olonne in the Vendée region of France in November so that the sailors can cross the roughest seas during the summer. The return takes place in the same location three or four months later. Armel Le Cléac'h holds the record for this crossing, which he set during the 2016-2017 edition, completing the journey in 74 days, 3 hours, 35 minutes, and 46 seconds, but the slowest competitors can take more than 150 days.

And here is the same race according to flat-Earthers:



So the question for some might be: what's wrong...?

The Vendée Globe participants are expected to circumnavigate 16/18ths of Antarctica, starting from Vendée to Gough Island and returning via Cape Horn, in an average duration of 80 to 100 days. The IMOCA 60 monohull sailboats used for this race have a speed of between 1.5 and 15 knots, with an average speed of 14.43 knots (25 km/h) during the race.

The Vendée Globe course covers an area of 21,638 miles, or 40,075 kilometers. The skippers participating in the race must circumnavigate the globe, passing three capes: Good Hope, Leeuwin and Horn, all without stopping and without assistance.

That being said, let's move on to the calculations!

The distance from the North Pole to the coasts of Antarctica is 15,000 km. This therefore gives us a flat Earth with a radius of 15,000 km.

Therefore, a flat Earth circumference of:

$$\emptyset = 2\pi R = 94{,}248 \text{ km}$$

at the level of the supposed imaginary ice wall.

The Flat Earth Society gives us the diameter of the flat Earth as being 40,000 km, which would make:

$$\emptyset = 2\pi R = 125{,}663 \text{ km}$$

We therefore take 16/18 of the circumference of Antarctica, which gives us:

$$94'248 \cdot \frac{16}{18} = 776 \text{ km}$$

For a diameter of 30,000 km or:

$$125'663 \cdot \frac{16}{18} = 701 \text{ km}$$

for a diameter of 40,000 km.

Then, we add the distance from Les Sables d'Olonne to Gough Island to reach the Arctic Circle, approximately 7,000 km, and the return distance from Cape Horn to Les Sables d'Olonne, approximately 13,000 km. This gives us:

- 103 776 km for a diameter of 30 000 km
- 132 701 km for a diameter of 40 000 km

Therefore, to complete the competition path at an average speed of 14.43 knots, the boats would take:

- 161.86 days for a flat Earth with a diameter of 30 000 km
- 206 days for a flat Earth with a diameter of 40 000 km

That's almost double of the 80 or 100 days usually spent by participants in the Vendée. Not to mention the number of kilometers, which is completely unrealistic!

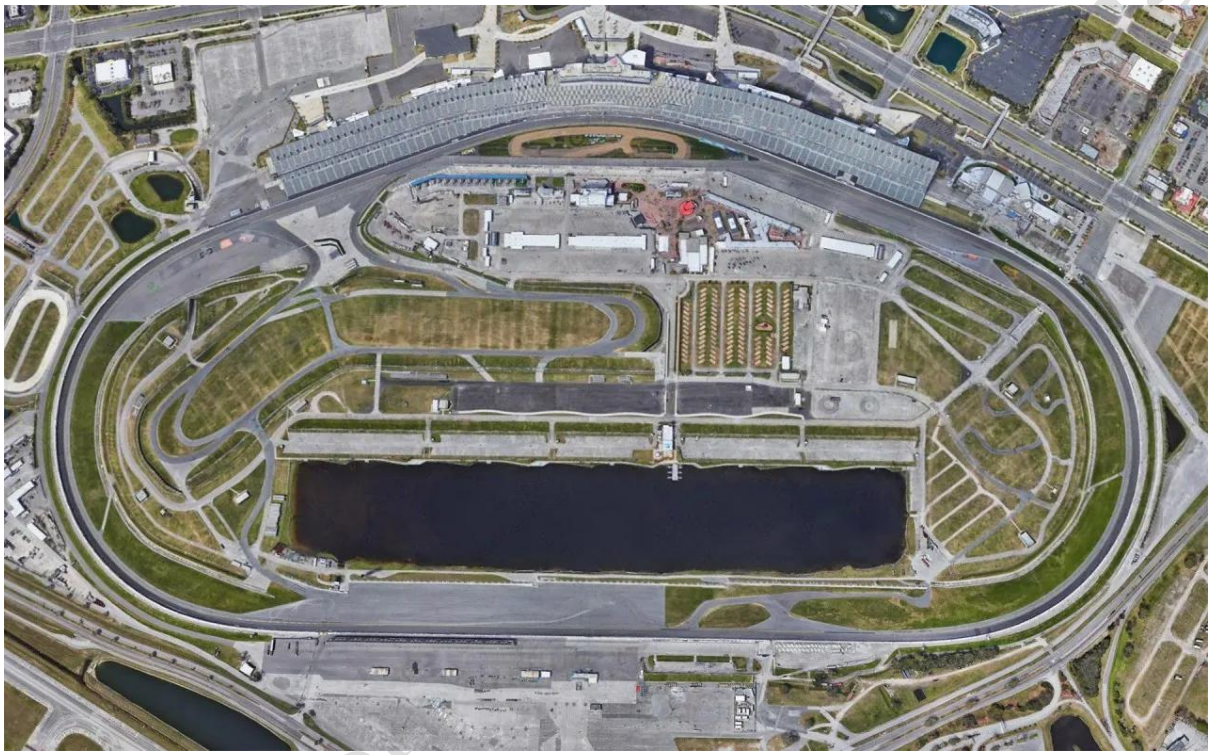
Anecdotally, the shape of the Vendée Globe cup is… a globe!

translation into english ongoing

(#283) Daytona International Speedway

The Daytona International Speedway is an iconic race track located in Daytona Beach, Florida (United States). Opened in 1959, it is best known for hosting the Daytona 500, the most prestigious race in NASCAR (National Association for Stock Car Auto Racing).

This circuit is a 4.02 km long “tri-oval” with 31-degree banked turns, allowing high speeds and excellent visibility for spectators. It can accommodate up to 147,000 seated spectators. In addition to NASCAR, it hosts a variety of competitions, such as the 24 Hours of Daytona, motorcycle races, and even karting.



The complex covers approximately 73 hectares, including an artificial lake, the Lloyd Lake, used for boat races. It is a place steeped in history and a must-see for motorsport enthusiasts.

Belden, a company specializing in cabling and connectivity solutions, played a key role in the modernization of Daytona International Speedway. As part of the "DAYTONA Rising" project, a $400 million initiative to transform the track into a state-of-the-art facility, Belden supplie33d reliable AV cables to support HD technologies and meet the growing needs of fans.

This includes the installation of systems to enhance the spectator experience, such as outdoor HD screens, speakers for public announcements, and infrastructure enabling seamless connectivity for thousands of visitors.

In its project presentation file available here:

https://peaketechnologies.net/wp-content/uploads/2019/09/Belden_Daytona.pdf

Belden confirms on page 3 of the PDF that it had to take into account the curvature of the Earth for its work:

Challenge

Investing in infrastructure to support technology now, and well into the future, was important to serve excited fans and their expectations.

Sticking to a tight timeline that did not disrupt motorsports events was crucial. The new systems and cabling installed during race season needed to be compatible with the venue's existing systems to prevent disruption. "The revenue and net income contribution this property offers to our business is significant, and we couldn't cut that pipeline off," says Craig Neeb, Vice President, Business Development and Chief Digital Officer for International Speedway Corporation. "We had to complete the project over a two-and-a-half-year period while still seamlessly running events."

Construction and installation were also challenging due to the sheer size and design of the venue. The new stadium is nearly one mile long, and DAYTONA Rising designs and solutions had to compensate for seven inches of the earth's curvature.

Reference books mentioning the globe

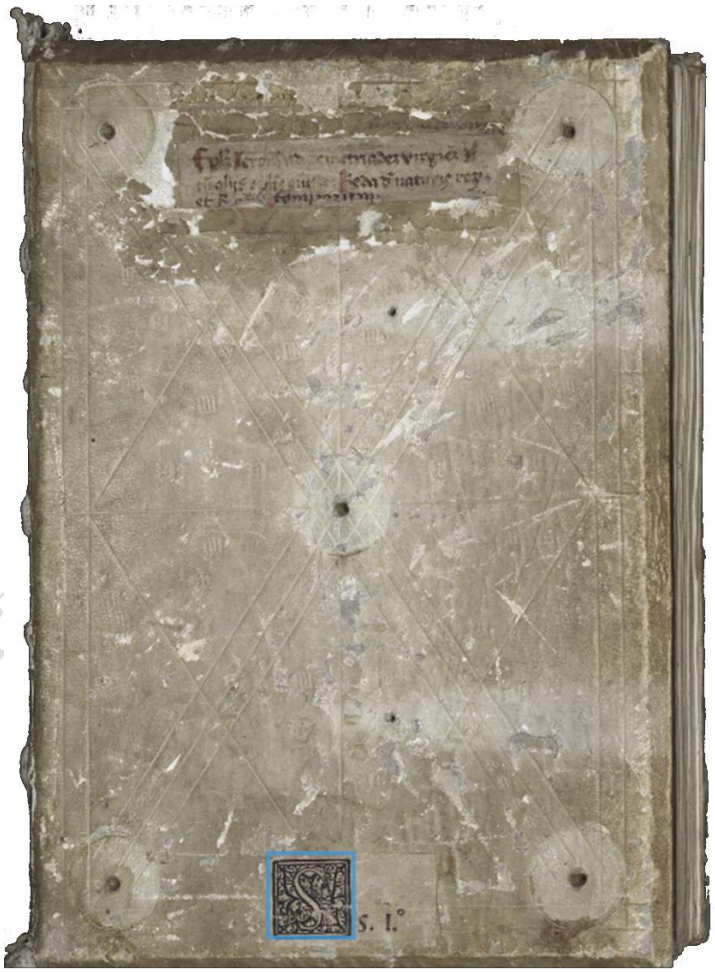
We will show here what several encyclopedias and other reference books say about the shape of the Earth. It will also be interesting for the reader to note the dates, since proponents of the flat Earth, in their usual lies, claim that the concept of the Earth as a globe has only been taught in schools since the early 1900s.

(#284) De Temporum Ratione (725)

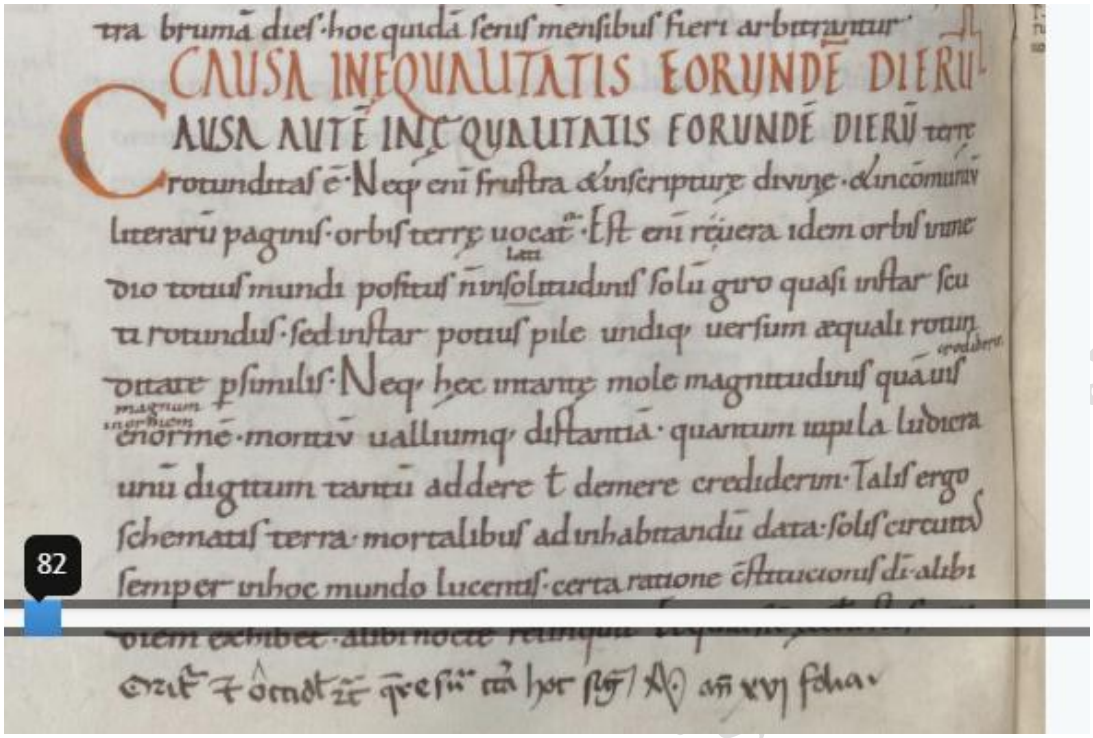
Bede the Venerable wrote *De Temporum Ratione* ("On the Calculation of Time"). His work deals with computus, the science of the calendar, and in particular the calculation of the date of Easter, a complex calculation that takes into account the movements of the Sun and the Moon. Bede addresses the problem of the Earth's shape in a way that leaves no room for doubt!

In a copy of his 8th century work, a scan of which is available here:

https://www.bavarikon.de/object/bav:BSB-HSS-00000BSB00065181?lang=de



At page 82 :



When taken from a book that translates the original entirely into English:

32. WHY THE SAME DAYS ARE UNEQUAL IN LENGTH

The reason why the same [calendar] days are of unequal length is the roundness of the Earth, for not without reason is it called "the orb of the world" on the pages of Holy Scripture and of ordinary literature. It is, in fact, a sphere set in the middle of the whole universe. It is not merely circular like a shield [or] spread out like a wheel, but resembles more a ball, being equally round in all directions, but not in a mass of equal magnitude – although I would believe that the enormous distance of mountains and valleys neither adds to it nor diminishes it any more than a finger would a playing ball.[281]

278 Pliny, *HN* 2.74.182–2.77.187 (1.314–318). "Thus it happens that … by ship from Britain." Cf. Bede, *On Times* 7.

279 Solinus, *Collectanea rerum memorabilium* 22.9, ed. Th. Mommsen (Berlin: Weidmann, 1895):101.11–102.2; cf. Isidore, *Etym.* 14.6.4.

280 Pliny, *HN* 4.16.104 (2.198). All the MSS agree that Bede refers to the *seventh* book of Pliny, though the quotation comes from the fourth. On the possibility that Bede used an anthology of Pliny excerpts, see Introduction, section 5. Perhaps the passage was misidentified in this abridgement.

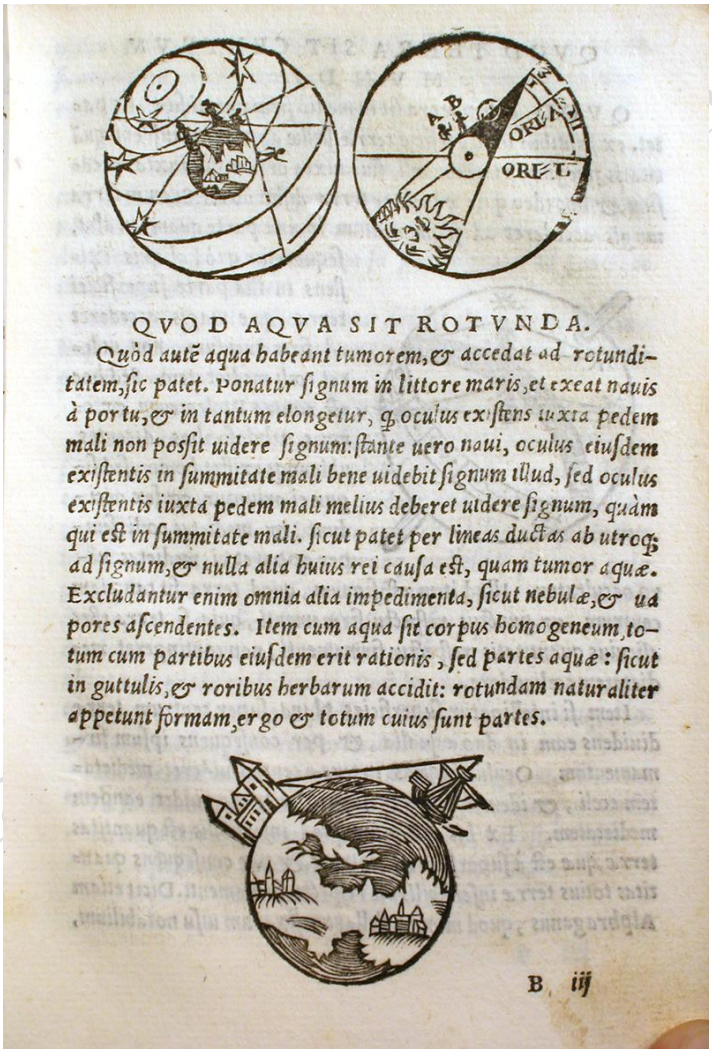
281 "The reason why … playing ball." Cf. Pliny, *HN* 2.64.160 (2.294–296). The seemingly ineradicable belief that medieval people thought the world to be flat, and considered it heretical to think otherwise, was refuted by C.W. Jones in "The Flat Earth", *Thought* 9 (1934):296–307. The weed continues to flourish nonetheless, though one hopes that it will be

(#285) Tractactus de Sphaera (1472)

Joannes de Sacrobosco was born in late XIIth century in Great Britain.

His book lays out the foundations of pre-Copernican astronomy, as it was taught in the Middle Ages: a synthesis of Ptolemy and his Arab commentators, it develops a simple and coherent cosmology. For this reason, *Sphaera's Tractatus* was immediately adopted by the University of Paris, and by the mid-13th century by all the universities of the Western world. Widely copied, it naturally became the first astronomy book printed, in 1472, in Ferrara. There were no fewer than 65 editions up to 1647, including 30 incunabula.

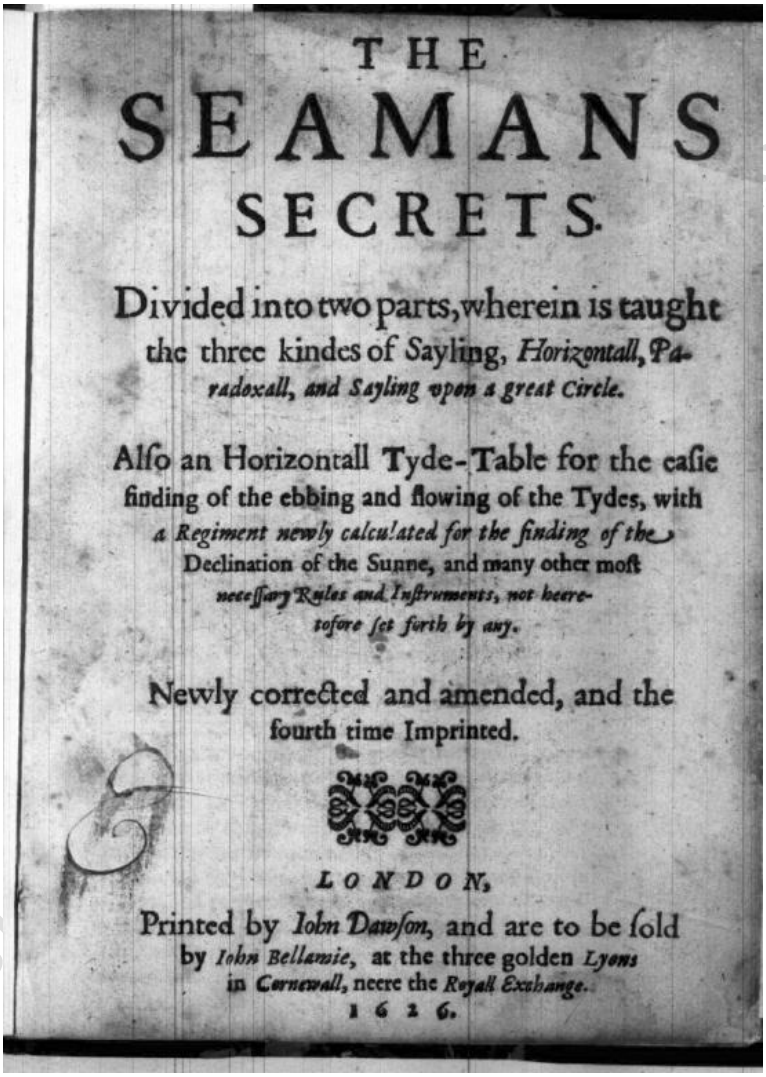
One of the first pages of Sphaera's Tractatus of 1472:


A B
ORIZ
ORIZ
QVOD AQVA SIT ROTVNDA.
Quòd autẽ aqua habeant tumorem, & accedat ad rotunditatem, ſic patet. Ponatur ſignum in littore maris, et exeat nauis à portu, & in tantum elongetur, q̃ oculus exiſtens iuxta pedem mali non poſſit uidere ſignum: ſtante uero naui, oculus eiuſdem exiſtentis in ſummitate mali bene uidebit ſignum illud, ſed oculus exiſtentis iuxta pedem mali melius deberet uidere ſignum, quàm qui eſt in ſummitate mali. ſicut patet per lineas ductas ab utroq; ad ſignum, & nulla alia huius rei cauſa eſt, quam tumor aquæ. Excludantur enim omnia alia impedimenta, ſicut nebulæ, & uapores aſcendentes. Item cum aqua ſit corpus homogeneum, totum cum partibus eiuſdem erit rationis, ſed partes aquæ: ſicut in guttulis, & roribus herbarum accidit: rotundam naturaliter appetunt formam, ergo & totum cuius ſunt partes.
B iij

The page above about the shape of the Earth leaves no doubt: The Earth is indeed considered a sphere!

(#286) The Seamans Secrets (1626)

The Seaman's Secrets is a practical navigation manual written by the English navigator John Davis (c.1550–1605), one of the most skilled seafarers of the late 16th century. The book distills techniques Davis had refined during his voyages in search of the Northwest Passage, offering sailors clear instruction in horizontal, paradoxical, and great-circle sailing, as well as guidance on tides, declination of the sun, and the use of essential nautical instruments. It became one of the foundational English texts for early modern navigation, valued for its clarity and its grounding in real maritime experience.



THE
SEAMANS
SECRETS.

Divided into two parts, wherein is taught the three kindes of Sayling, *Horizontall, Paradoxall, and Sayling upon a great Circle.*

Alſo an Horizontall Tyde-Table for the eaſie finding of the ebbing and flowing of the Tydes, with *a Regiment newly calculated for the finding of the* Declination of the Sunne, and many other moſt *neceſſary Rules and Inſtruments, not heeretofore ſet forth by any.*

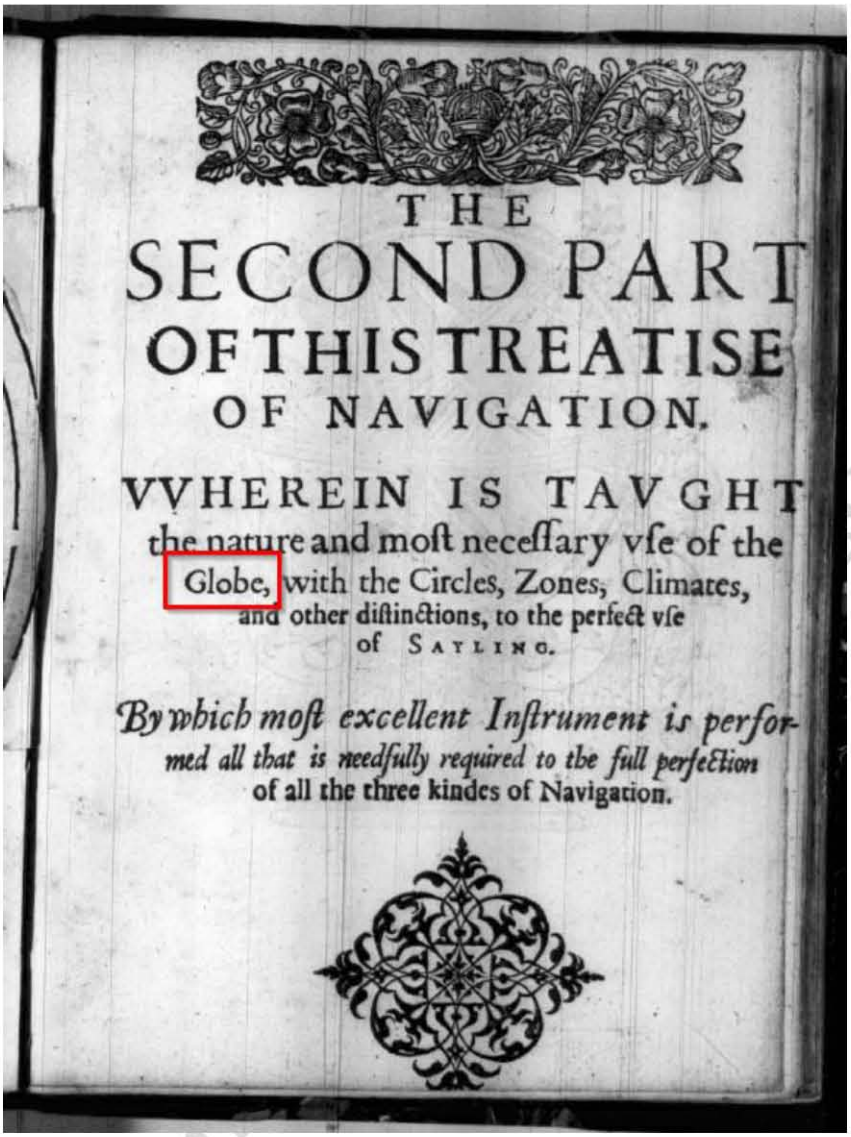
Newly corrected and amended, and the fourth time Imprinted.

LONDON,

Printed by *Iohn Dawſon*, and are to be ſold by *Iohn Bellamie*, at the three golden *Lyons* in *Cornewall*, neere the *Royall Exchange*.

1626.

The book mentions 36 times the Earth is a globe, like for exemple on the first page of the second part of the book:



THE
SECOND PART
OF THIS TREATISE
OF NAVIGATION.

VVHEREIN IS TAVGHT
the nature and moſt neceſſary vſe of the
Globe, with the Circles, Zones, Climates,
and other diſtinctions, to the perfect vſe
of SAYLING.

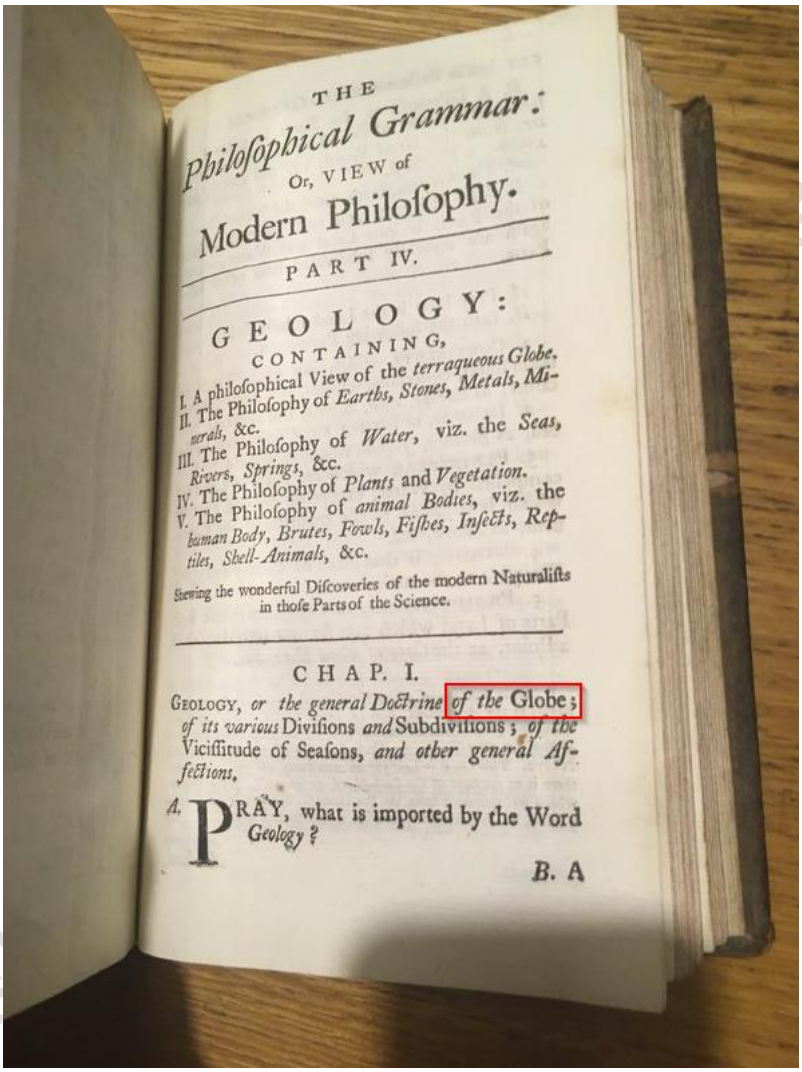
By which moſt excellent Inſtrument is perfor-
med all that is needfully required to the full perfection
of all the three kindes of Navigation.

translation ongoing

(#287) The Philosophical Grammar: being a view of the present state of experimental Physiology, or Natural Philosophy (1738)

Book by Martin Benjamin (1704-1782) published by John Noon, London in 1738.

Here is a chapter from a popular science book dating from 1738 (yes, a real science book designed for the general public that is almost 300 years old!!!), almost 50 years before the creation of the United States of America:



THE
Philosophical Grammar:
Or, VIEW of
Modern Philosophy.
PART IV.

GEOLOGY:
CONTAINING,
I. A philosophical View of the *terraqueous Globe.*
II. The Philosophy of *Earths, Stones, Metals, Minerals,* &c.
III. The Philosophy of *Water,* viz. the *Seas, Rivers, Springs,* &c.
IV. The Philosophy of *Plants* and *Vegetation.*
V. The Philosophy of *animal Bodies,* viz. the *human Body, Brutes, Fowls, Fishes, Insects, Reptiles, Shell-Animals,* &c.

Shewing the wonderful Discoveries of the modern Naturalists in those Parts of the Science.

CHAP. I.

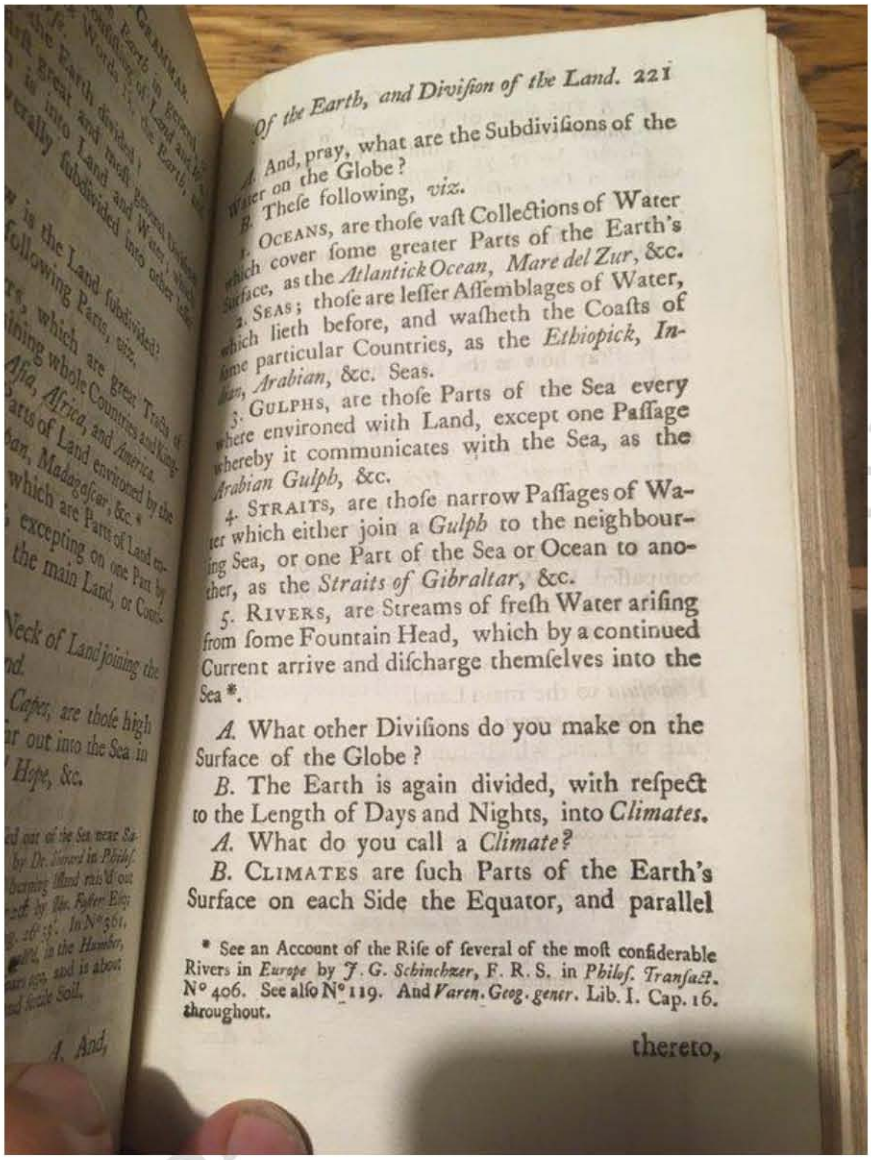
GEOLOGY, *or the general Doctrine of the* Globe; *of its various* Divisions *and* Subdivisions; *of the* Vicissitude of Seasons, *and other general Affections.*

A. PRAY, what is imported by the Word *Geology?*

B. A

We have highlighted in the photo above with a red rectangle the mention of the shape of the Earth for geological analysis purposes.

We also have numerous mentions of the word "Globe" on page 221:



Of the Earth, and Diviſion of the Land. 221

A. And, pray, what are the Subdiviſions of the Water on the Globe?

B. Theſe following, *viz.*

1. OCEANS, are thoſe vaſt Collections of Water which cover ſome greater Parts of the Earth's Surface, as the *Atlantick Ocean*, *Mare del Zur*, &c.

2. SEAS; thoſe are leſſer Aſſemblages of Water, which lieth before, and waſheth the Coaſts of ſome particular Countries, as the *Ethiopick*, *Indian*, *Arabian*, &c. Seas.

3. GULPHS, are thoſe Parts of the Sea every where environed with Land, except one Paſſage whereby it communicates with the Sea, as the *Arabian Gulph*, &c.

4. STRAITS, are thoſe narrow Paſſages of Water which either join a *Gulph* to the neighbouring Sea, or one Part of the Sea or Ocean to another, as the *Straits of Gibraltar*, &c.

5. RIVERS, are Streams of freſh Water ariſing from ſome Fountain Head, which by a continued Current arrive and diſcharge themſelves into the Sea *.

A. What other Diviſions do you make on the Surface of the Globe?

B. The Earth is again divided, with reſpect to the Length of Days and Nights, into *Climates*.

A. What do you call a *Climate*?

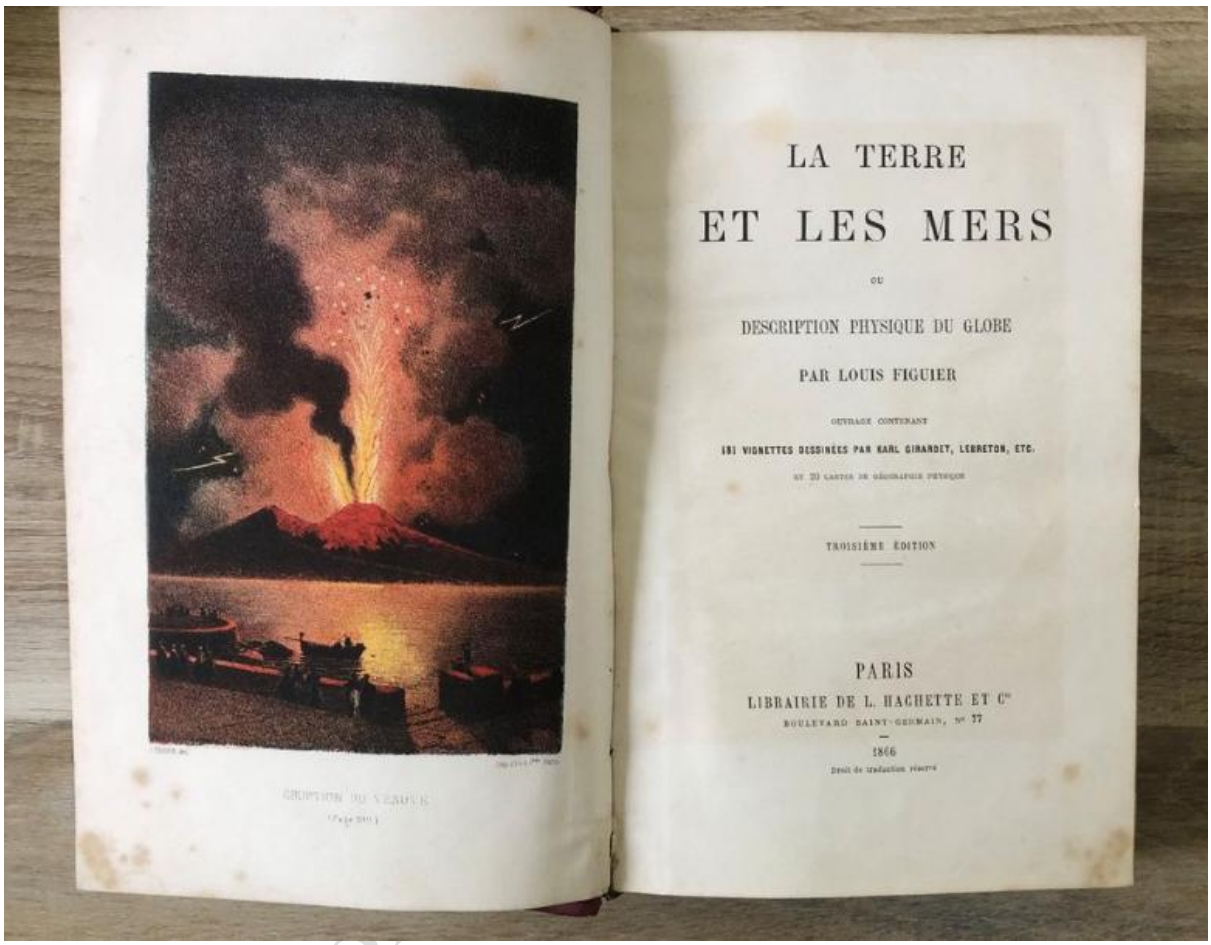
B. CLIMATES are ſuch Parts of the Earth's Surface on each Side the Equator, and parallel

* See an Account of the Riſe of ſeveral of the moſt conſiderable Rivers in *Europe* by *J. G. Schinchzer*, F. R. S. in *Philoſ. Tranſact.* N° 406. See alſo N° 119. And *Varen. Geog. gener.* Lib. I. Cap. 16. throughout.

thereto,

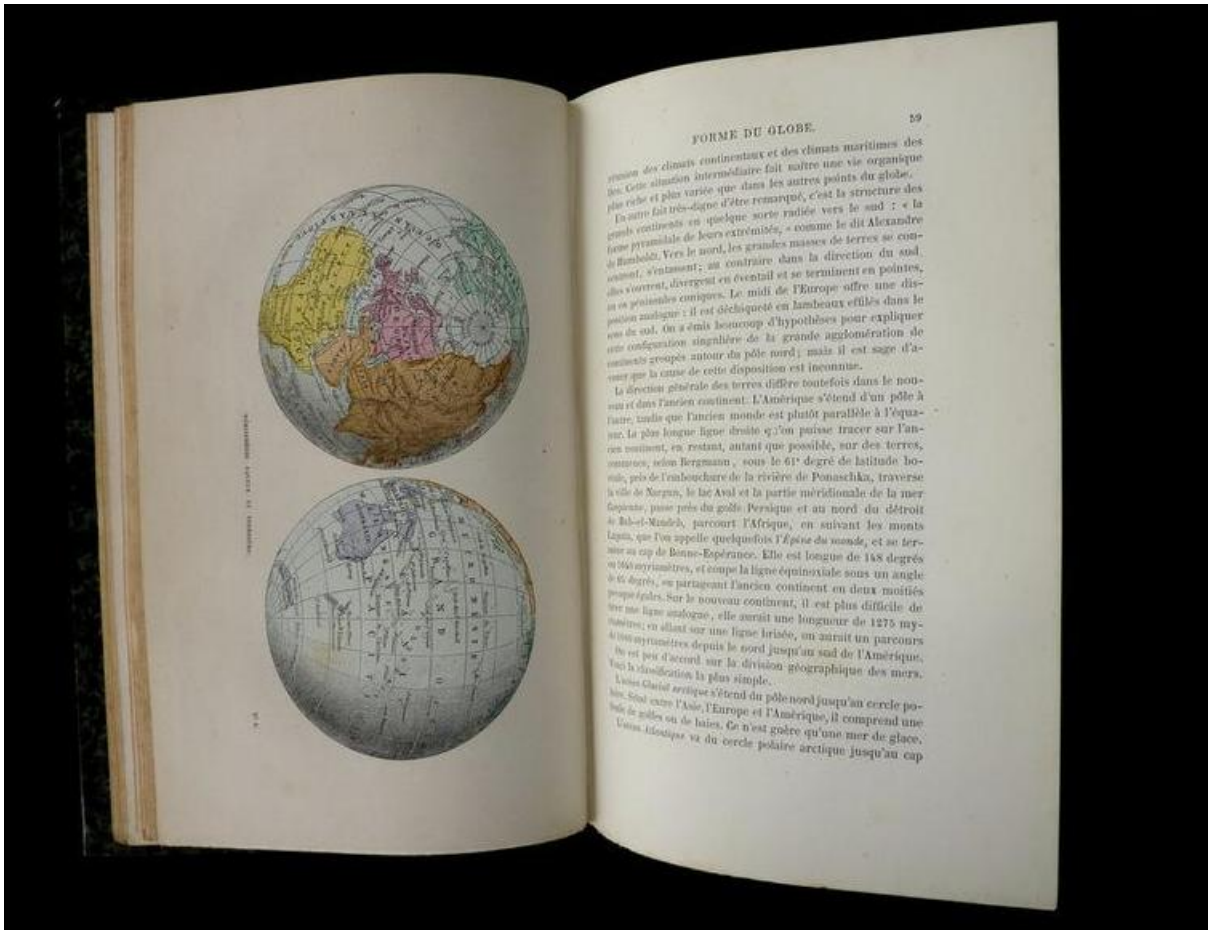
(#288) La Terre et les Mers – Description Physique du Globe (Hachette 1866)

La Terre et les Mers – Description Physique du Globe ("The Earth and the Seas – Physical Description of the Globe") is a book by Louis Figuier (1819-1894) published by Libraire de L. Hachette in 1866:



Here is a photo from this popular science book dating from 1866 in French which shows once again that the Earth as a globe was already an obvious fact about 160 years ago:

translation



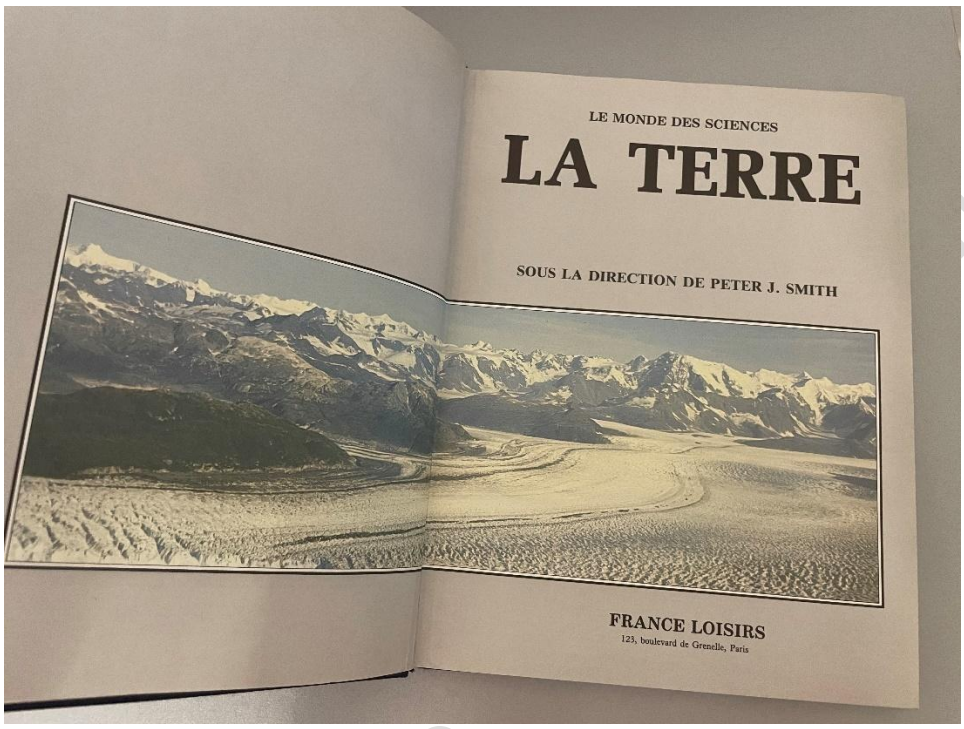
FORME DU GLOBE. 59

Nothing to add...

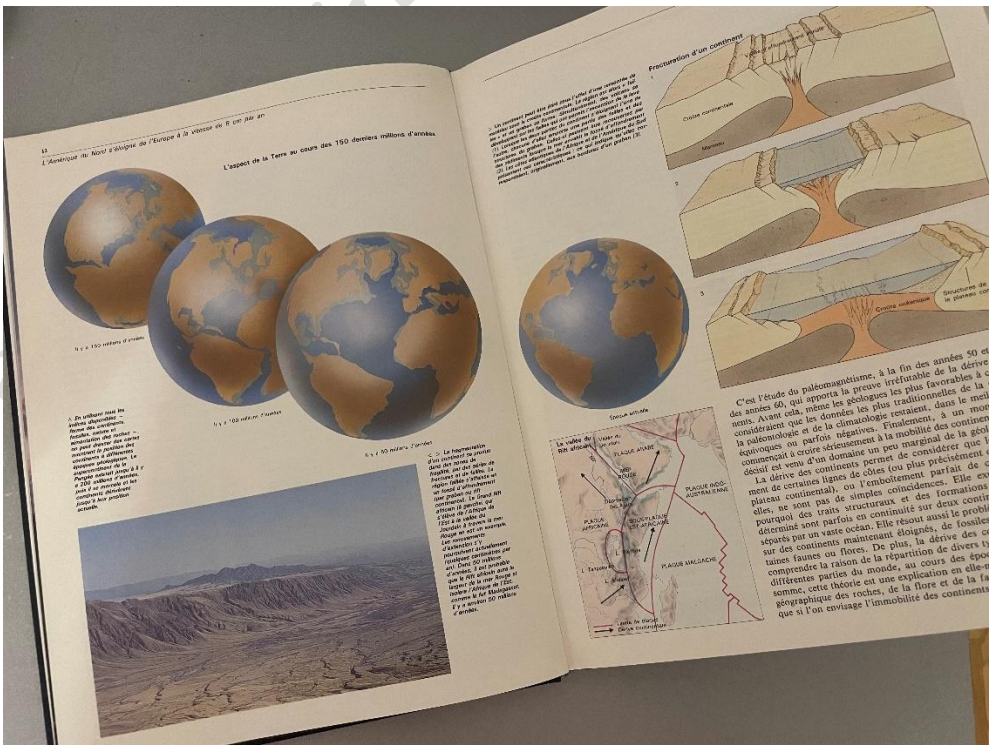
translation into

(#289) Encyclopédie Terre (France Loisirs 1985)

In its encyclopedia *Le Monde des Sciences – LA TERRE* (“The World of Science – THE EARTH”) (edited by Peter J. Smith) published by France Loisirs (123, boulevard de Grenelle, Paris) produced by Equinox Oxford Ltd. in 1985, ISBN 2-7242-4440-0

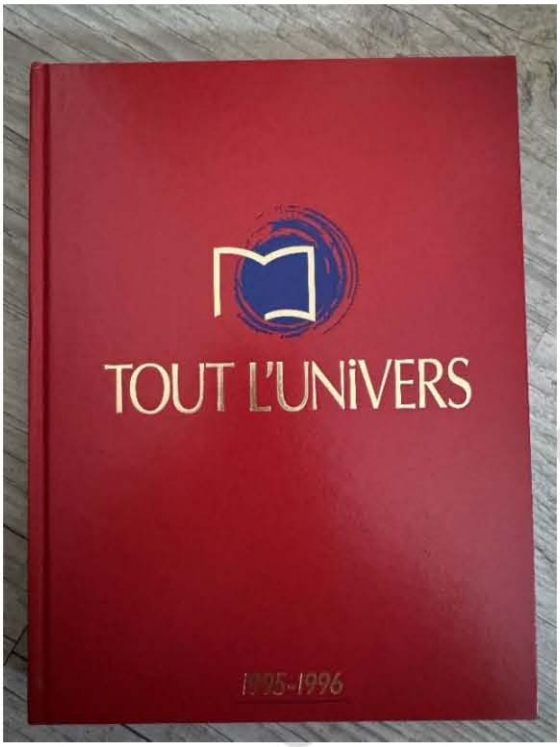


And we have at the page 12:



(#290) Tout l'Univers (Hachette 1995-1996)

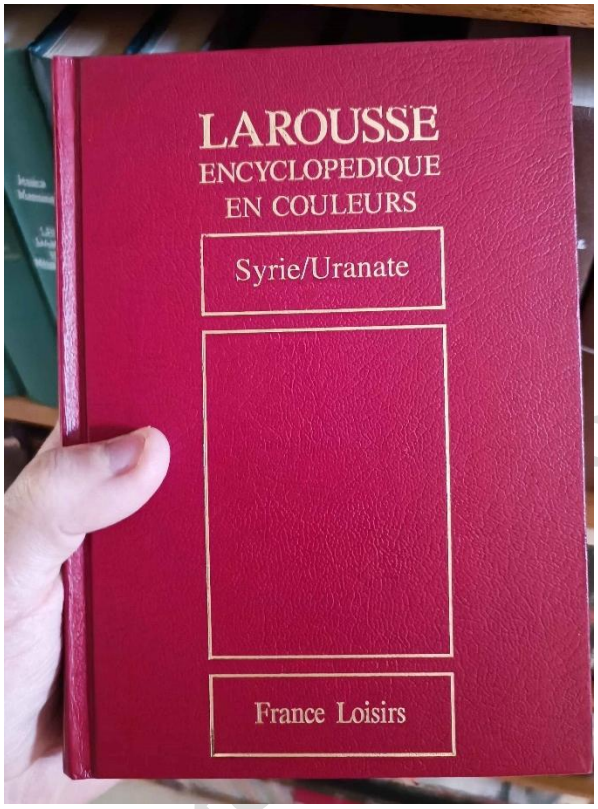
In *Tout l'Univers* ("All the Universe") from the Éditions Hachette, printed in Italy in 1996 by the presses of the Canale printing house (Turin), ISBN 2-245-00348-8:



We have :

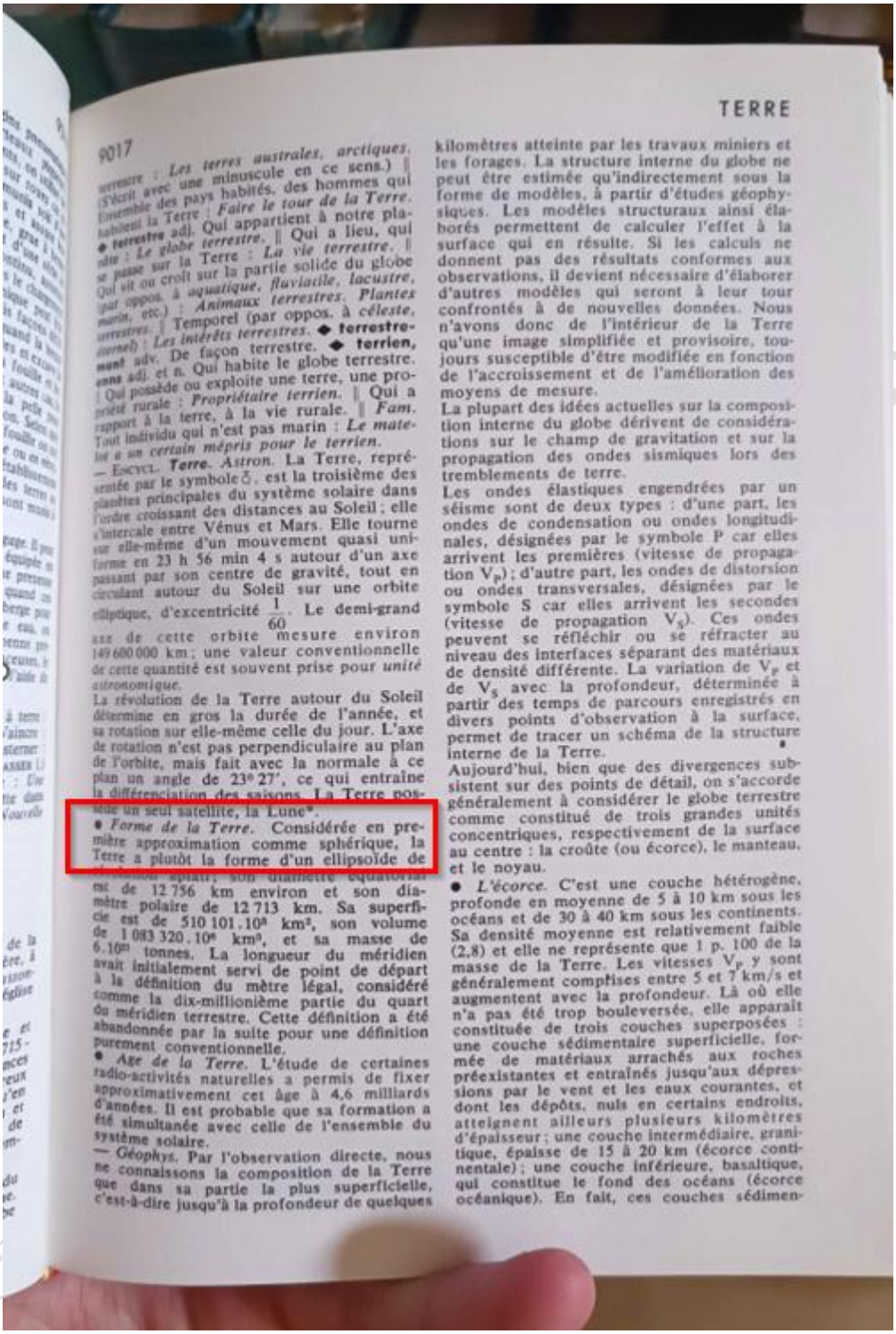
(#291) Encyclopédie Larousse (France Loisirs 1993)

We have the *Larousse Encyclopédique* in color Syria/Uranata from 1993 (first edition 1979), # Publisher 23984, ISBN 2-7242-0729-7, France Loisirs:



On page 9017 concerning the shape of the Earth, we have the specification that it is approximately spherical:

translation in progress



TERRE

9017

terrestre : *Les terres australes, arctiques.* (S'écrit avec une minuscule en ce sens.) ‖ Ensemble des pays habités, des hommes qui habitent la Terre : *Faire le tour de la Terre.* ◆ **terrestre** adj. Qui appartient à notre planète : *Le globe terrestre.* ‖ Qui a lieu, qui se passe sur la Terre : *La vie terrestre.* ‖ Qui vit ou croît sur la partie solide du globe (par oppos. à *aquatique, fluviatile, lacustre, marin,* etc.) : *Animaux terrestres. Plantes terrestres.* ‖ Temporel (par oppos. à *céleste, éternel*) : *Les intérêts terrestres.* ◆ **terrestrement** adv. De façon terrestre. ◆ **terrien, enne** adj. et n. Qui habite le globe terrestre. ‖ Qui possède ou exploite une terre, une propriété rurale : *Propriétaire terrien.* ‖ Qui a rapport à la terre, à la vie rurale. ‖ *Fam.* Tout individu qui n'est pas marin : *Le matelot a un certain mépris pour le terrien.*

— ENCYCL. **Terre.** *Astron.* La Terre, représentée par le symbole ♁, est la troisième des planètes principales du système solaire dans l'ordre croissant des distances au Soleil ; elle s'intercale entre Vénus et Mars. Elle tourne sur elle-même d'un mouvement quasi uniforme en 23 h 56 min 4 s autour d'un axe passant par son centre de gravité, tout en circulant autour du Soleil sur une orbite elliptique, d'excentricité $\frac{1}{60}$. Le demi-grand axe de cette orbite mesure environ 149 600 000 km ; une valeur conventionnelle de cette quantité est souvent prise pour *unité astronomique.*

La révolution de la Terre autour du Soleil détermine en gros la durée de l'année, et sa rotation sur elle-même celle du jour. L'axe de rotation n'est pas perpendiculaire au plan de l'orbite, mais fait avec la normale à ce plan un angle de 23° 27', ce qui entraîne la différenciation des saisons. La Terre possède un seul satellite, la Lune*.

● *Forme de la Terre.* Considérée en première approximation comme sphérique, la Terre a plutôt la forme d'un ellipsoïde de [illegible] aplati ; son diamètre équatorial est de 12 756 km environ et son diamètre polaire de 12 713 km. Sa superficie est de $510\,101.10^8$ km², son volume de $1\,083\,320.10^6$ km³, et sa masse de 6.10^{21} tonnes. La longueur du méridien avait initialement servi de point de départ à la définition du mètre légal, considéré comme la dix-millionième partie du quart du méridien terrestre. Cette définition a été abandonnée par la suite pour une définition purement conventionnelle.

● *Age de la Terre.* L'étude de certaines radio-activités naturelles a permis de fixer approximativement cet âge à 4,6 milliards d'années. Il est probable que sa formation a été simultanée avec celle de l'ensemble du système solaire.

— *Géophys.* Par l'observation directe, nous ne connaissons la composition de la Terre que dans sa partie la plus superficielle, c'est-à-dire jusqu'à la profondeur de quelques kilomètres atteinte par les travaux miniers et les forages. La structure interne du globe ne peut être estimée qu'indirectement sous la forme de modèles, à partir d'études géophysiques. Les modèles structuraux ainsi élaborés permettent de calculer l'effet à la surface qui en résulte. Si les calculs ne donnent pas des résultats conformes aux observations, il devient nécessaire d'élaborer d'autres modèles qui seront à leur tour confrontés à de nouvelles données. Nous n'avons donc de l'intérieur de la Terre qu'une image simplifiée et provisoire, toujours susceptible d'être modifiée en fonction de l'accroissement et de l'amélioration des moyens de mesure.

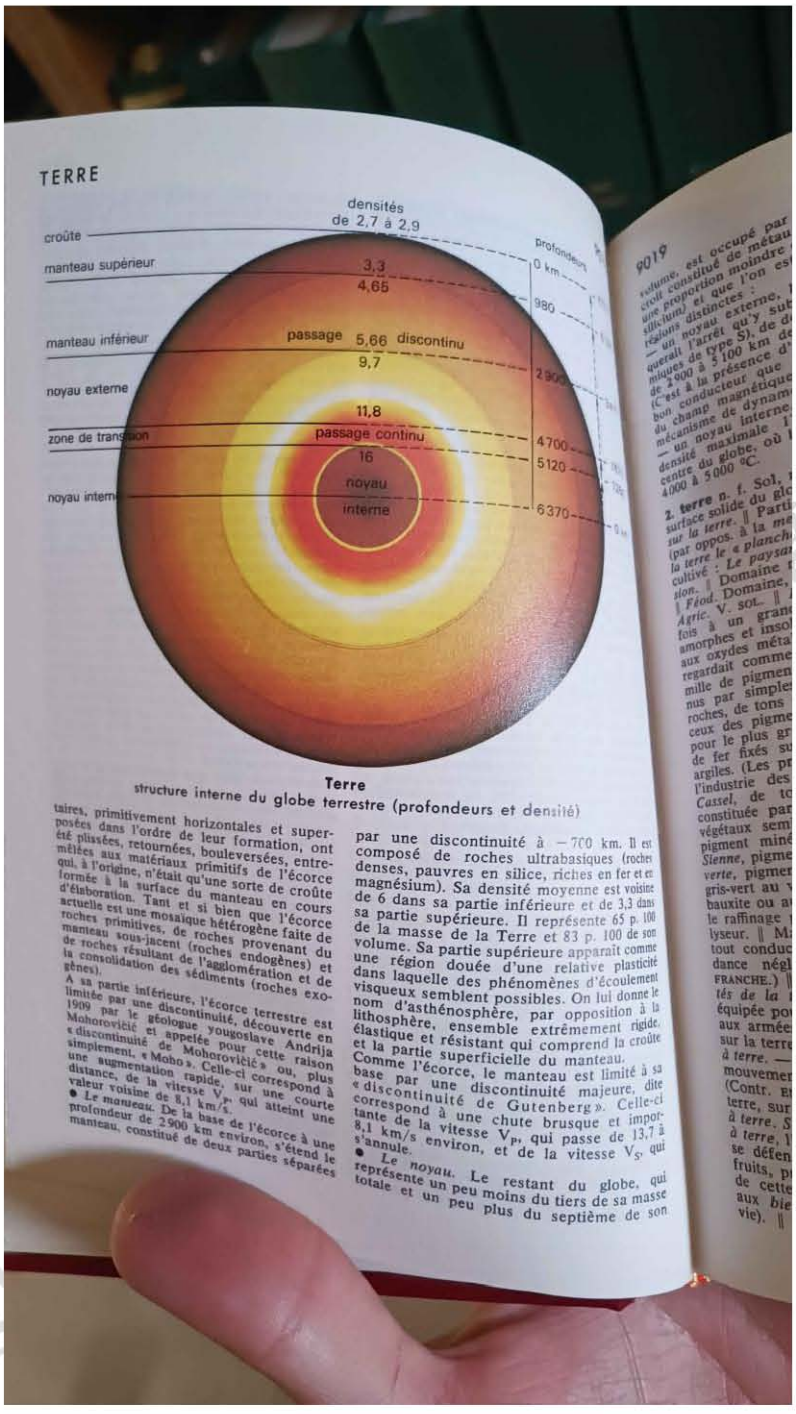
La plupart des idées actuelles sur la composition interne du globe dérivent de considérations sur le champ de gravitation et sur la propagation des ondes sismiques lors des tremblements de terre.

Les ondes élastiques engendrées par un séisme sont de deux types : d'une part, les ondes de condensation ou ondes longitudinales, désignées par le symbole P car elles arrivent les premières (vitesse de propagation V_P) ; d'autre part, les ondes de distorsion ou ondes transversales, désignées par le symbole S car elles arrivent les secondes (vitesse de propagation V_S). Ces ondes peuvent se réfléchir ou se réfracter au niveau des interfaces séparant des matériaux de densité différente. La variation de V_P et de V_S avec la profondeur, déterminée à partir des temps de parcours enregistrés en divers points d'observation à la surface, permet de tracer un schéma de la structure interne de la Terre.

Aujourd'hui, bien que des divergences subsistent sur des points de détail, on s'accorde généralement à considérer le globe terrestre comme constitué de trois grandes unités concentriques, respectivement de la surface au centre : la croûte (ou écorce), le manteau, et le noyau.

● *L'écorce.* C'est une couche hétérogène, profonde en moyenne de 5 à 10 km sous les océans et de 30 à 40 km sous les continents. Sa densité moyenne est relativement faible (2,8) et elle ne représente que 1 p. 100 de la masse de la Terre. Les vitesses V_P y sont généralement comprises entre 5 et 7 km/s et augmentent avec la profondeur. Là où elle n'a pas été trop bouleversée, elle apparaît constituée de trois couches superposées : une couche sédimentaire superficielle, formée de matériaux arrachés aux roches préexistantes et entraînés jusqu'aux dépressions par le vent et les eaux courantes, et dont les dépôts, nuls en certains endroits, atteignent ailleurs plusieurs kilomètres d'épaisseur ; une couche intermédiaire, granitique, épaisse de 15 à 20 km (écorce continentale) ; une couche inférieure, basaltique, qui constitue le fond des océans (écorce océanique). En fait, ces couches sédimen-

And also an illustration depicting the textual description:



Terre

structure interne du globe terrestre (profondeurs et densité)

taires, primitivement horizontales et superposées dans l'ordre de leur formation, ont été plissées, retournées, bouleversées, entremêlées aux matériaux primitifs de l'écorce qui, à l'origine, n'était qu'une sorte de croûte formée à la surface du manteau en cours d'élaboration. Tant et si bien que l'écorce actuelle est une mosaïque hétérogène faite de roches primitives, de roches provenant du manteau sous-jacent (roches endogènes) et de roches résultant de l'agglomération et de la consolidation des sédiments (roches exogènes).

A sa partie inférieure, l'écorce terrestre est limitée par une discontinuité, découverte en 1909 par le géologue yougoslave Andrija Mohorovičić et appelée pour cette raison « discontinuité de Mohorovičić » ou, plus simplement, « Mohо ». Celle-ci correspond à une augmentation rapide, sur une courte distance, de la vitesse V_P, qui atteint une valeur voisine de 8,1 km/s.

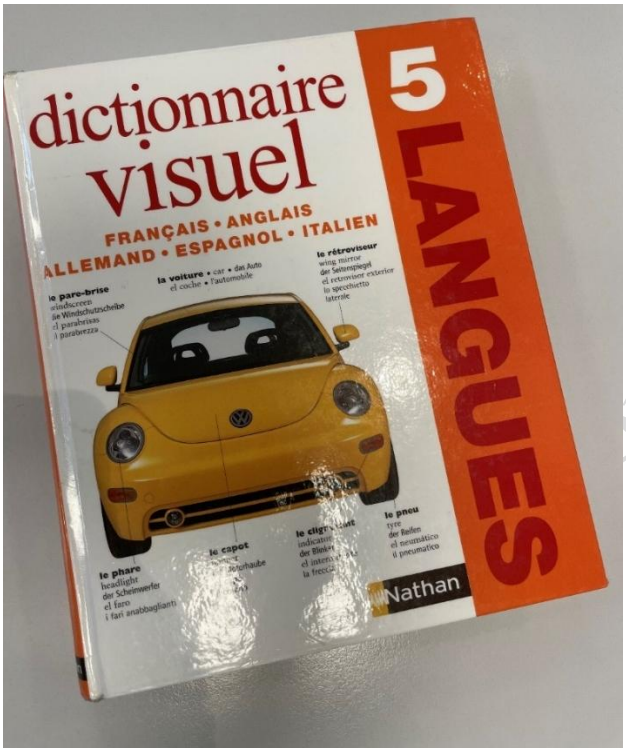
● *Le manteau.* De la base de l'écorce à une profondeur de 2 900 km environ, s'étend le manteau, constitué de deux parties séparées par une discontinuité à − 700 km. Il est composé de roches ultrabasiques (roches denses, pauvres en silice, riches en fer et en magnésium). Sa densité moyenne est voisine de 6 dans sa partie inférieure et de 3,3 dans sa partie supérieure. Il représente 65 p. 100 de la masse de la Terre et 83 p. 100 de son volume. Sa partie supérieure apparaît comme une région douée d'une relative plasticité dans laquelle des phénomènes d'écoulement visqueux semblent possibles. On lui donne le nom d'asthénosphère, par opposition à la lithosphère, ensemble extrêmement rigide, élastique et résistant qui comprend la croûte et la partie superficielle du manteau.

Comme l'écorce, le manteau est limité à sa base par une discontinuité majeure, dite « discontinuité de Gutenberg ». Celle-ci correspond à une chute brusque et importante de la vitesse V_P, qui passe de 13,7 à 8,1 km/s environ, et de la vitesse V_S, qui s'annule.

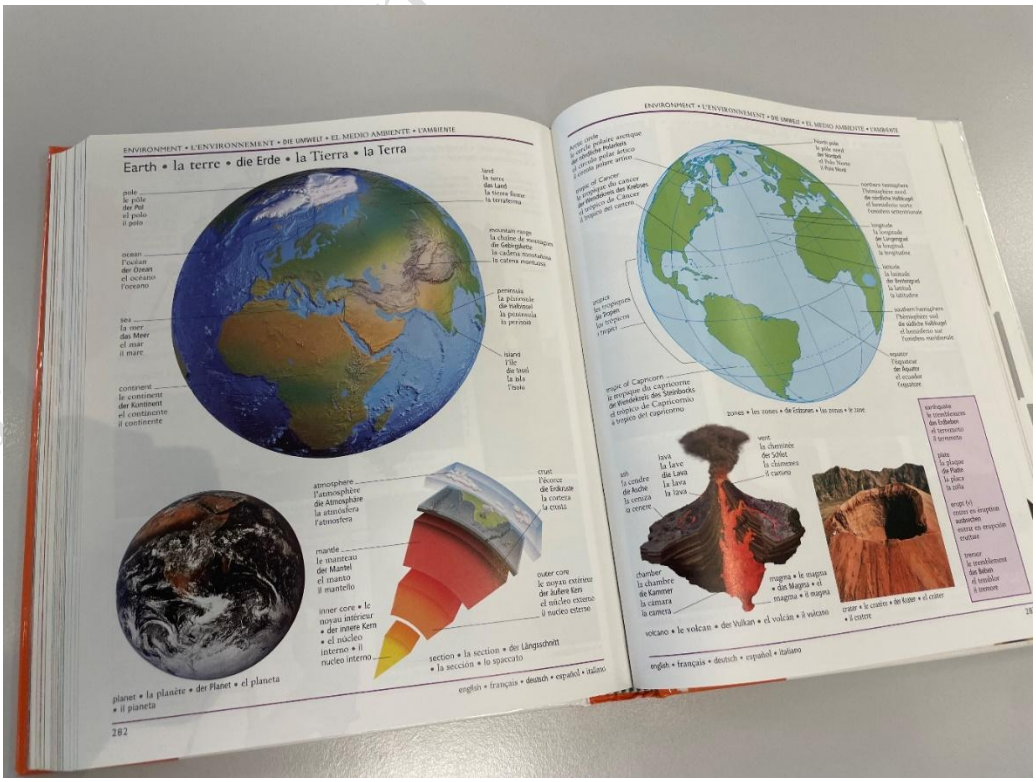
● *Le noyau.* Le restant du globe, qui représente un peu moins du tiers de sa masse totale et un peu plus du septième de son

(#292) Dictionnaire Visuel (français, anglais, allemand, espagnol, italien / 2003)

In the *Dictionnaire visuel* (“Visual Dictionary” of Nathan Publishing, 2003 edition, ISBN-2-09-886914-3:



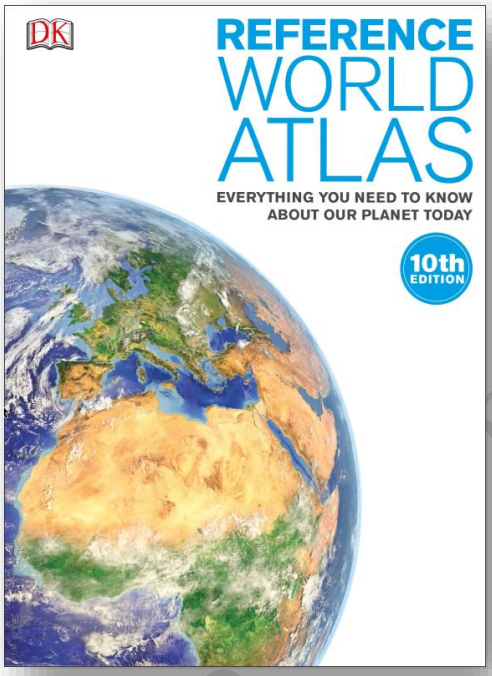
We have at page 241 :



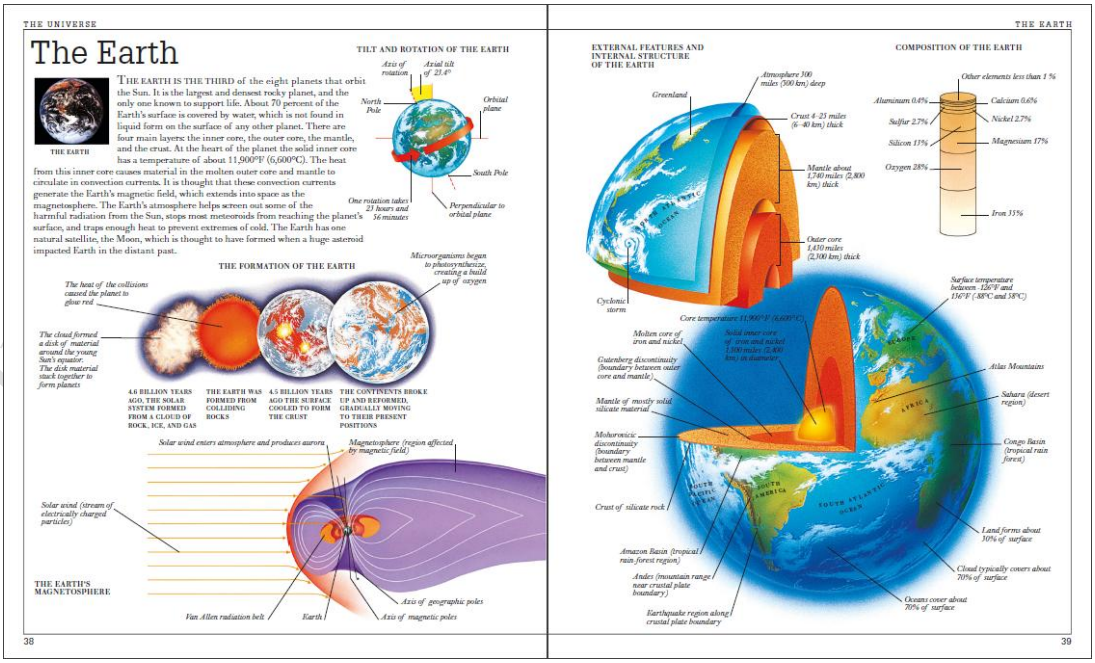
(#293) Reference World Atlas (2016)

In the 2016 *Reference World Atlas* (first published in Great Britain in 1997), ISBN 978-0-2412-2633-9 (printed and bound in Hong Kong).

The cover page speaks for itself:

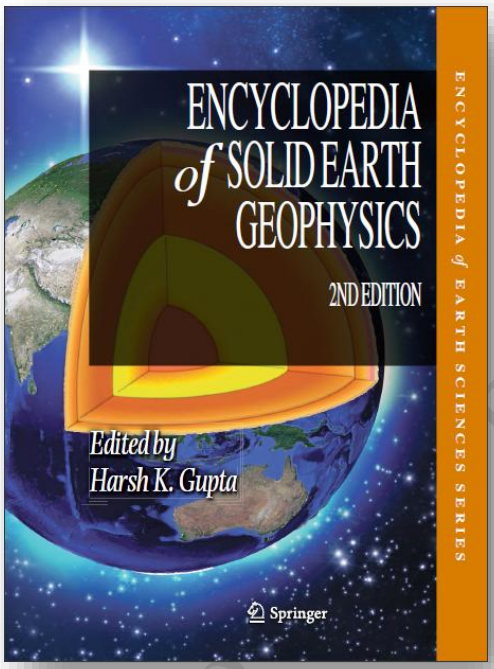


But if you're interested, here's ANOTHER page of its content:

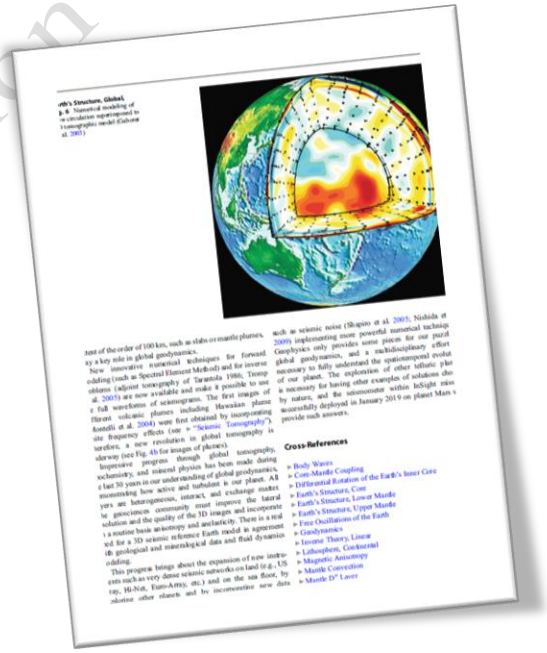

THE UNIVERSE
The Earth
THE EARTH IS THE THIRD of the eight planets that orbit the Sun. It is the largest and densest rocky planet, and the only one known to support life. About 70 percent of the Earth's surface is covered by water, which is not found in liquid form on the surface of any other planet. There are four main layers: the inner core, the outer core, the mantle, and the crust. At the heart of the planet the solid inner core has a temperature of about 11,900°F (6,600°C). The heat from this inner core causes material in the molten outer core and mantle to circulate in convection currents. It is thought that these convection currents generate the Earth's magnetic field, which extends into space as the magnetosphere. The Earth's atmosphere helps screen out some of the harmful radiation from the Sun, stops most meteoroids from reaching the planet's surface, and traps enough heat to prevent extremes of cold. The Earth has one natural satellite, the Moon, which is thought to have formed when a huge asteroid impacted Earth in the distant past.
THE EARTH
TILT AND ROTATION OF THE EARTH
Axis of rotation
Axial tilt of 23.4°
North Pole
Orbital plane
South Pole
One rotation takes 23 hours and 56 minutes
Perpendicular to orbital plane
THE FORMATION OF THE EARTH
The heat of the collisions caused the planet to glow red
Microorganisms began to photosynthesize, creating a build up of oxygen
The cloud formed a disk of material around the young Sun's equator. The disk material stuck together to form planets
4.6 BILLION YEARS AGO, THE SOLAR SYSTEM FORMED FROM A CLOUD OF ROCK, ICE, AND GAS
THE EARTH WAS FORMED FROM COLLIDING ROCKS
4.5 BILLION YEARS AGO THE SURFACE COOLED TO FORM THE CRUST
THE CONTINENTS BROKE UP AND REFORMED, GRADUALLY MOVING TO THEIR PRESENT POSITIONS
Solar wind enters atmosphere and produces aurora
Magnetosphere (region affected by magnetic field)
Solar wind (stream of electrically charged particles)
THE EARTH'S MAGNETOSPHERE
Van Allen radiation belt
Earth
Axis of geographic poles
Axis of magnetic poles
38
THE EARTH
EXTERNAL FEATURES AND INTERNAL STRUCTURE OF THE EARTH
Atmosphere 300 miles (500 km) deep
Greenland
Crust 4–25 miles (6–40 km) thick
Mantle about 1,740 miles (2,800 km) thick
Outer core 1,430 miles (2,300 km) thick
Cyclonic storm
Core temperature 11,900°F (6,600°C)
Molten core of iron and nickel
Solid inner core of iron and nickel 1,500 miles (2,400 km) in diameter
Gutenberg discontinuity (boundary between outer core and mantle)
Mantle of mostly solid silicate material
Mohorovicic discontinuity (boundary between mantle and crust)
Crust of silicate rock
Amazon Basin (tropical rain forest region)
Andes (mountain range near crustal plate boundary)
Earthquake region along crustal plate boundary
COMPOSITION OF THE EARTH
Other elements less than 1 %
Aluminum 0.4%
Calcium 0.6%
Sulfur 2.7%
Nickel 2.7%
Silicon 15%
Magnesium 17%
Oxygen 28%
Iron 35%
Surface temperature between -126°F and 136°F (-88°C and 58°C)
Atlas Mountains
Sahara (desert region)
Congo Basin (tropical rain forest)
Land forms about 30% of surface
Cloud typically covers about 70% of surface
Oceans cover about 70% of surface
39

(#294) Encyclopedia of Solid Earth & Geophysics (2021)

In the *Encyclopedia of Solid Earth Geophysics* edited by Harsh K. Gupta (of the National Geophysical Research Centre, Industrial Research Advisor in India) and published by Springer (a peer-reviewed academic press), ISBN number 978-3-030-58630-0, the cover page speaks for itself:



But if you're interested, here's a page of its content:



translation into English ongoing

(#295) Wikipedia General Encyclopedia (2024)

Let's see what Wikipedia, the most consulted and academically sourced encyclopedia in the world (to date), has to say:

https://en.wikipedia.org/wiki/Empirical_evidence_for_the_spherical_shape_of_Earth

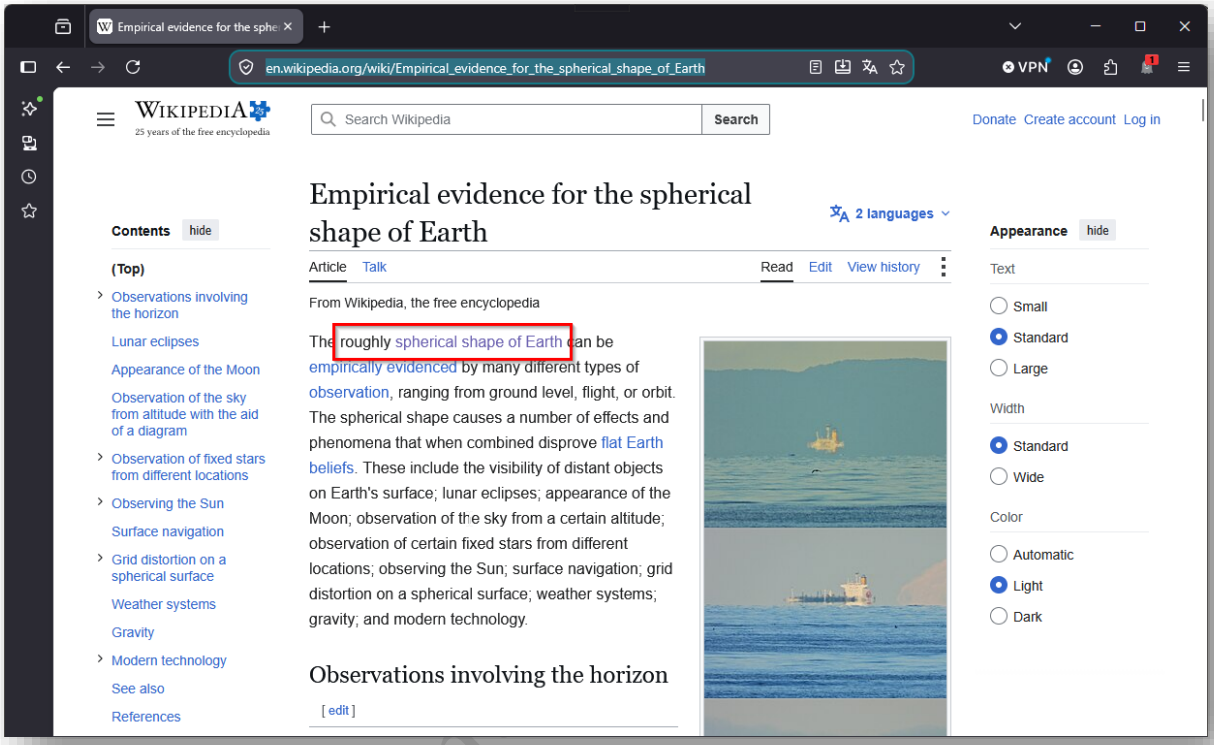

Empirical evidence for the sphe
en.wikipedia.org/wiki/Empirical_evidence_for_the_spherical_shape_of_Earth
VPN
WIKIPEDIA
25 years of the free encyclopedia
Search Wikipedia
Search
Donate Create account Log in
Empirical evidence for the spherical shape of Earth
2 languages
Contents hide
(Top)
Observations involving the horizon
Lunar eclipses
Appearance of the Moon
Observation of the sky from altitude with the aid of a diagram
Observation of fixed stars from different locations
Observing the Sun
Surface navigation
Grid distortion on a spherical surface
Weather systems
Gravity
Modern technology
See also
References
Article Talk
Read Edit View history
From Wikipedia, the free encyclopedia
The roughly spherical shape of Earth can be empirically evidenced by many different types of observation, ranging from ground level, flight, or orbit. The spherical shape causes a number of effects and phenomena that when combined disprove flat Earth beliefs. These include the visibility of distant objects on Earth's surface; lunar eclipses; appearance of the Moon; observation of the sky from a certain altitude; observation of certain fixed stars from different locations; observing the Sun; surface navigation; grid distortion on a spherical surface; weather systems; gravity; and modern technology.
Observations involving the horizon
[edit]
Appearance hide
Text
Small
Standard
Large
Width
Standard
Wide
Color
Automatic
Light
Dark

Figure 153 Screenshot from Wikipedia, August 2026, on the page about the shape of the Earth

translation in

(#296) Globes in schools and museums

If we make arguments of the same (kindergarten-) level as a certain author of a book on the flat Earth… then the fact that schools and universities as well as museums have a 3D representation of the Earth which is always a globe and never a disc is therefore "proof" (…) that the Earth is a globe (obviously it is not "proof" but we force ourselves to put ourselves on the same level of argumentation as some proponents of the flat Earth).

Figure 154 Globe in a school classroom (Sierra Leone, January 2015 credit: GPE/Stephan Bachenheimer)

Figure 155 A photo taken on June 3, 2019 shows models and structures on astronomy and galaxies inside the Clock Tower Museum in the Saudi holy city of Mecca (credit: Agence France Presse)

Since proponents use the antiquity fallacy to claim that the Earth is flat because there is a (clearly flat) map from 1517 showing a flat Earth…, let us remind them that the oldest globe dates from 1493:

Figure 156 Globe of Martin Behaim (photo taken on March 31, 2006 by Alexander Franke, source: Wikipedia)

It is the oldest known surviving terrestrial globe and one of the last representations of the world as it was known before Christopher Columbus reached the Caribbean islands (October1492), during his first voyage, which led to the discovery of the "New World".

It was made on commission from the council of the Free Imperial City of Nuremberg, by several craftsmen working under the direction of Martin Behaim.

It is a metal sphere with a diameter of 51 cm, now on display at the German National Museum in Nuremberg.

translation into Chinese ongoing

An **Earth globe** is a **spherical model of Earth** with a similar use to maps, but **without the distortions** except to scale it down. The **Greeks** from **3rd century BC** knew **Earth is a sphere** & the **earliest globe** appeared from that period.

Flat-Earthers take the appearance of a **globe** before NASA existed as a sign of misconduct. They incorrectly claim it is impossible to know **spherical Earth** before the first space-flight. In reality, we knew **spherical Earth** since 3rd century BC & **globes** were already common far before spaceflight.

FlatEarth.ws/globe
Debunking Flat Earth Misconceptions
@thewizzman8

translati

Logos

There are international institutions that use the spherical Earth as their logo rather than a flat Earth with a ring around Antarctica (by the way the UN logo does not have a ring around Antarctica in its logo FYI…!).

translation

(#297) OECD Logo

We have the Organization for Economic Co-operation and Development (OECD), which is an intergovernmental organization for economic studies, whose member countries — most of them developed countries — share a democratic system of government and a market economy. It essentially plays the role of a consultative assembly.

They use a spherical Earth for their logo and not a flat Earth…

(#298) International Monetary Fund Logo

The International Monetary Fund (IMF) is an international institution bringing together 191 countries, whose aim is to "promote international monetary cooperation, guarantee financial stability, facilitate international trade, contribute to a high level of employment, economic stability and reduce poverty".

The logo contains two clearly visible terrestrial spheres and not any flat Earh… :

translation into english ongoing

(#299) Logo of the International Court of Justice

The International Court of Justice (ICJ), located in The Hague, Netherlands, in the Peace Palace, was established by Article 92 of the Charter of the United Nations: “The International Court of Justice shall be the principal judicial organ of the United Nations. It shall function in accordance with a Statute established on the basis of the Statute of the Permanent Court of International Justice and annexed to the present Charter, of which it forms an integral part.” Its principal functions are to settle legal disputes submitted by States and to give advisory opinions on legal questions submitted by international bodies and agencies approved by the General Assembly of the United Nations.

The logo contains two clearly visible terrestrial spheres and not a flat Earth:

translation in progress ongoing

(#300) FIFA logo and Football World Cup

The Fédération Internationale de Football Association (often referred to by the acronym FIFA) is the international sports federation for football, futsal and beach soccer. Association of national federations founded on May 21, 1904 in Paris, its mission is to manage and develop football in the world. The Football World Cup was created in 1924 by Jules Rimet, president of the international federation from 1920 to 1954.

The FIFA logo represents the sphere of the terrestrial globe and not a flat Earth...:

© 1977 FIFA®
FIFA®
For the Good of the Game

into english ongoing

The football World Cup also has a globe…:

We know that many flattards are football fans. Sorry for them…

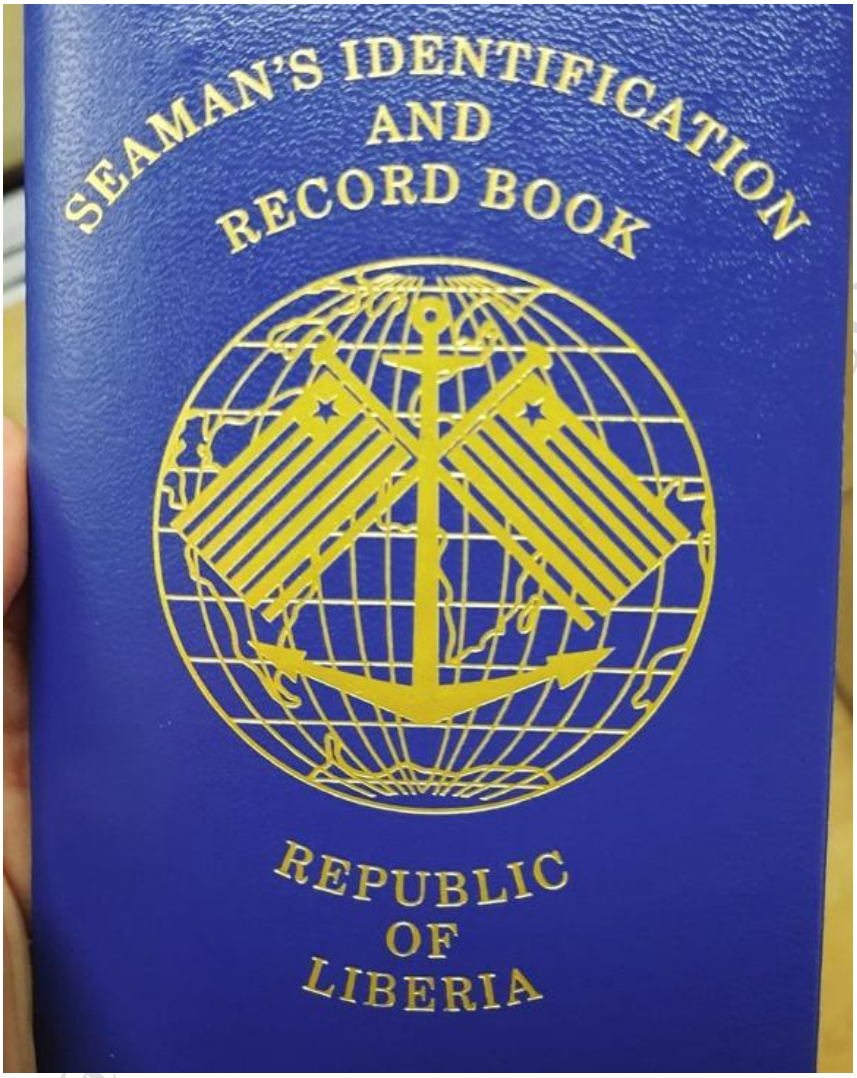
(#301) Hockey World Cup

And since there are also many flattards who are fans of hockey, let's remind them of the shape of the Men's Hockey World Cup shape:

translation ongoing

Liberia Seaman's Identification and Record Book

Let's see what the front cover of the book of records of identifications of marine navigators from Liberia looks like:



Oh, that's odd! A globe is used as front cover and not a flat Earth…

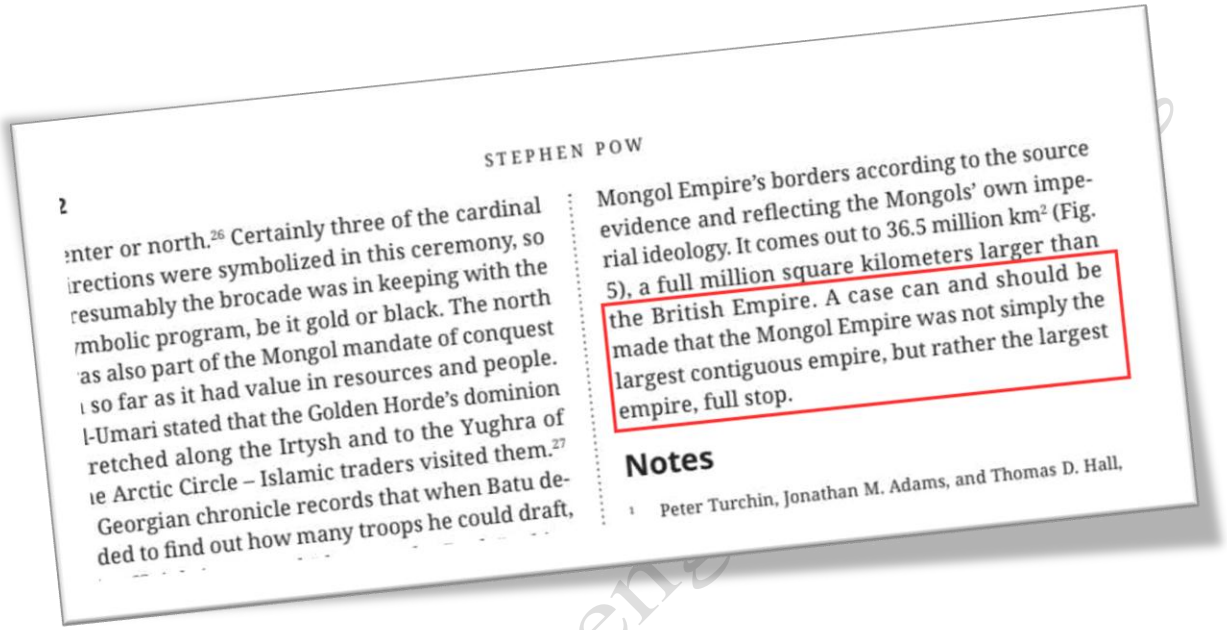
(#302) Announcement that the Earth is a globe by the Flat Earth Society

If we continue with the same kind of arguments of the same level as a certain author of a book on the flat Earth (yes, always the same one…), then even the Flat Earth Society in the United States admitted in a Tweet (on the social network "X" formerly "Twitter") that the Earth was a globe (obviously it is fake news but in this example we are forcing ourselves, reluctantly, to put ourselves at the same level of argumentation and manipulation of lies as some flattards).

Figure 157 Photoshop of the announcement that the members of the Flat Earth Society have members around the globe

(#303) The greatest empire of all time used globes

The greatest empire of all time is considered to be the Mongol Empire (13th-14th century), as attested by Stephen Pow (PhD in History, Research Associate at the University of Calgary) in his book (The Mongol Empire's Northern Border: Re-evualting the Surface Area of the Mongol Empire, 2018) :



STEPHEN POW

2

enter or north.[26] Certainly three of the cardinal directions were symbolized in this ceremony, so presumably the brocade was in keeping with the symbolic program, be it gold or black. The north was also part of the Mongol mandate of conquest as far as it had value in resources and people. al-Umari stated that the Golden Horde's dominion stretched along the Irtysh and to the Yughra of the Arctic Circle – Islamic traders visited them.[27] Georgian chronicle records that when Batu decided to find out how many troops he could draft,

Mongol Empire's borders according to the source evidence and reflecting the Mongols' own imperial ideology. It comes out to 36.5 million km² (Fig. 5), a full million square kilometers larger than the British Empire. A case can and should be made that the Mongol Empire was not simply the largest contiguous empire, but rather the largest empire, full stop.

Notes

1 Peter Turchin, Jonathan M. Adams, and Thomas D. Hall,

Figure 158Étendue de l'empire mongol a son paroxysme au 13e siècle (source : Wikipédia)

However, the Mongols considered the Earth to be a sphere. An archaeological artifact, such as the globe visible below, clearly attests this:

Figure 159 A celestial globe in gold and silver by the Muslim Muhammad ibn Muy-ayyad al-'Urdi Iran, 1297 (Mathematisch-Physikalisher Salon, Staatliche Kunstsammlungen (E II 1), Dresde)

translation into ongoing

Religious texts and objects that confirm the globe

Today there are three religions which give clear indications in their texts that the Earth is a globe. This is certainly not much compared to the 33 monotheistic religions currently practiced around the world, but it must be said that the majority of them do not focus on the shape of the Earth in their so-called "revealed" books.

(#304) Hinduism confirms the globe

The sacred texts of Hinduism clearly state that the Earth cannot be flat. For example, in the Aitareya Brahmana of the Rigveda 3.44, which dates from the 1st century BCE:

"*The Sun never sets or rises. When people believe that the Sun sets (it doesn't), because after reaching the end of the day, it produces two opposing effects, making night what is below and day what is on the other side…At the end of the night, it produces two opposing effects, making day what is below and night what is on the other side. In fact, the Sun never sets…*"

The same applies to another sacred text of Hinduism, the Śrīmad-Bhāgavatam 5.21.9 from the 10th century CE:

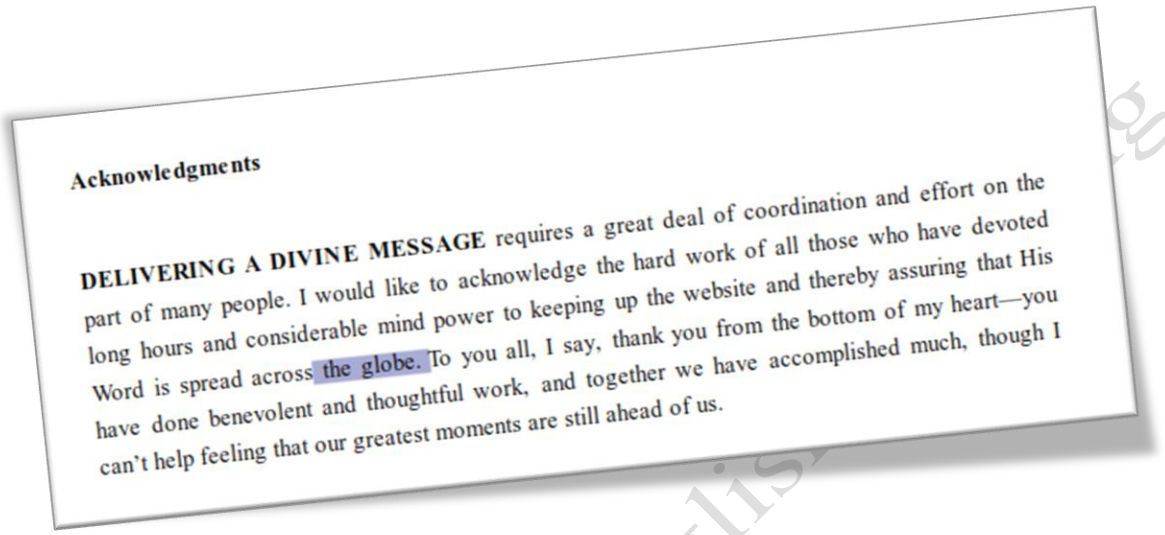
"*Inhabitants of countries located at points diametrically opposite to where the Sun first rises will see the Sun set, and if a straight line were drawn from a point where the Sun is at noon, inhabitants of countries located at the opposite end of the line would see the Sun set at midnight. Similarly, if inhabitants of countries where the Sun sets were to travel to diametrically opposite countries, they would not see the Sun under the same conditions*."

translation into english ongoing

(#305) Pastafarianism confirms the globe

Pastafarianism is a recent religion (2005) which, in its holy texts, confirms that the Earth is indeed a globe, as evidenced by the screenshots below taken from:

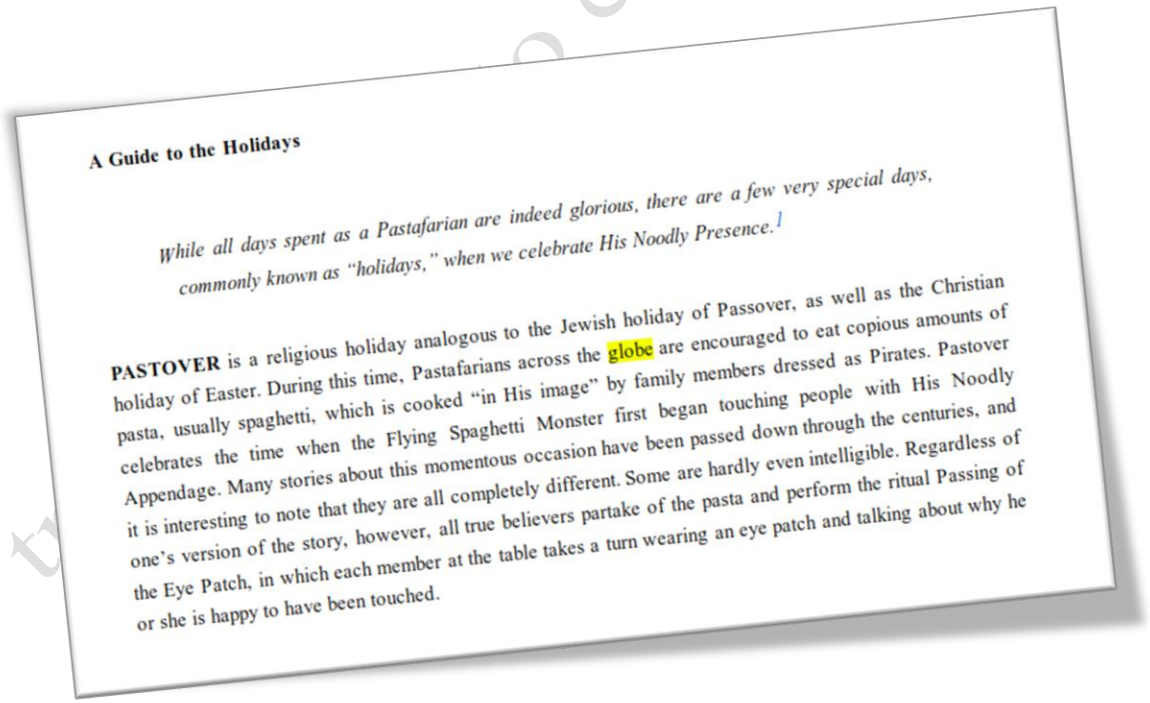
https://archive.org/details/TheGospelOfTheFlyingSpaghettiMonster/



Acknowledgments

DELIVERING A DIVINE MESSAGE requires a great deal of coordination and effort on the part of many people. I would like to acknowledge the hard work of all those who have devoted long hours and considerable mind power to keeping up the website and thereby assuring that His Word is spread across the globe. To you all, I say, thank you from the bottom of my heart—you have done benevolent and thoughtful work, and together we have accomplished much, though I can't help feeling that our greatest moments are still ahead of us.

And we also have in their holy texts:



A Guide to the Holidays

While all days spent as a Pastafarian are indeed glorious, there are a few very special days, commonly known as "holidays," when we celebrate His Noodly Presence.[1]

PASTOVER is a religious holiday analogous to the Jewish holiday of Passover, as well as the Christian holiday of Easter. During this time, Pastafarians across the globe are encouraged to eat copious amounts of pasta, usually spaghetti, which is cooked "in His image" by family members dressed as Pirates. Pastover celebrates the time when the Flying Spaghetti Monster first began touching people with His Noodly Appendage. Many stories about this momentous occasion have been passed down through the centuries, and it is interesting to note that they are all completely different. Some are hardly even intelligible. Regardless of one's version of the story, however, all true believers partake of the pasta and perform the ritual Passing of the Eye Patch, in which each member at the table takes a turn wearing an eye patch and talking about why he or she is happy to have been touched.

And :

every continent and every civilization around the globe. This evidence has been carefully cataloged by the scribes assigned to the great Pirate sailing vessels as they journey around the world gathering archaeological evidence of the Great One. The only continent they avoid is Antarctica, and that is because they know not to go there; Shackleton brought back records of what the ungrateful penguins tried to do to him and his crew when they were stranded there. This evidence spans the globe, made manifest in the chow mein noodles of China, the aspen noodles of Nebraska, the flying kangaroos of Australia, and the great megaghetti boats of the ancient Phoenicians. This should settle all debates over the influence of the Flying Spaghetti Monster.

translation into english ongoing

(#306) Medieval Christian art confirms the globe

The Salvator Mundi (Latin for "Savior of the World") is an oil painting on walnut wood, on the theme of Christ the Redeemer, attributed by several experts to Leonardo da Vinci in whole or in part, or to one of his pupils, Bernardino Luini or Giovanni Antonio Boltraffio.

It represents Christ in glory, giving his blessing with his right hand, with an orb in his left hand sometimes representing the Earth's sphere.

For example, we have (observe the spherical orb with the continents):

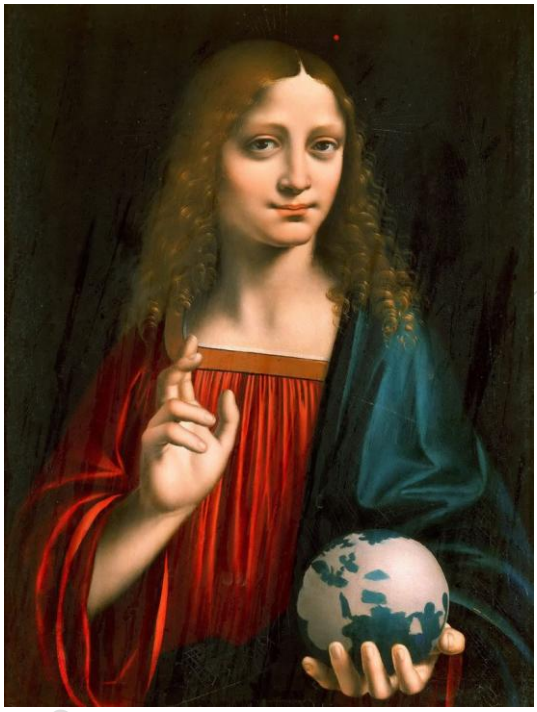


Figure 160 Marco d'Oggiono, Salvator Mundi (year 1500), Galerie Borghèse, Roma (Italy)

Or again (again observe the spherical orb with the continents!):

translation ongoing

Figure 161 Circle of Vinci, The Savior of the World, circa 1505; Museum of Fine Arts of Nancy (France)

Or again (observe the spherical orb with the continents):

Figure 162 Salai, Cristo giovanetto come Salvator Mundi, Museo Ideale Leonardo da Vinci, Vinci before 1524 (Italy)

Or again… (observe the spherical orb with the continents):

translation in progress

Figure 163 Giampietrino, Salvator Mundi, befpre 1550,Pouchkine, Moscow museum (Russia)

Remember that according to flattards, it is the United States that is lying to the world that the Earth is a sphere. But judging from the paintings above, and even before the United States existed, the largest Abrahamic religion recognized that the Earth is a globe.

translation into english ongoing

(#307) Christianity validates the globe in the Douai Bible of 1609

The Douai Bible (Douay-Rheims Bible) is an English translation of the Bible from the Latin Vulgate, undertaken by members of the English College in Douai at the end of the 15th century. Their aim with this translation was to bolster Catholic tradition against the Protestant Reformation, which at that time held overwhelming sway over Elizabethan religion and scholarly debate. As such, it represents a significant contribution from English Catholics to the Counter-Reformation.

The New Testament was published in a single volume in 1582 in Reims. The Old Testament was published nearly thirty years later by the University of Douai in two volumes: the first, from Genesis to Job, appeared in 1609, and the second, from the Psalms to 2 Maccabees, including the Vulgate apocrypha, in 1610. The marginal notes, which are distinctly polemical and patristic in nature, occupy the greater part of the volumes. They also address certain translation problems and examine the Hebrew and Greek source texts of the Vulgate.

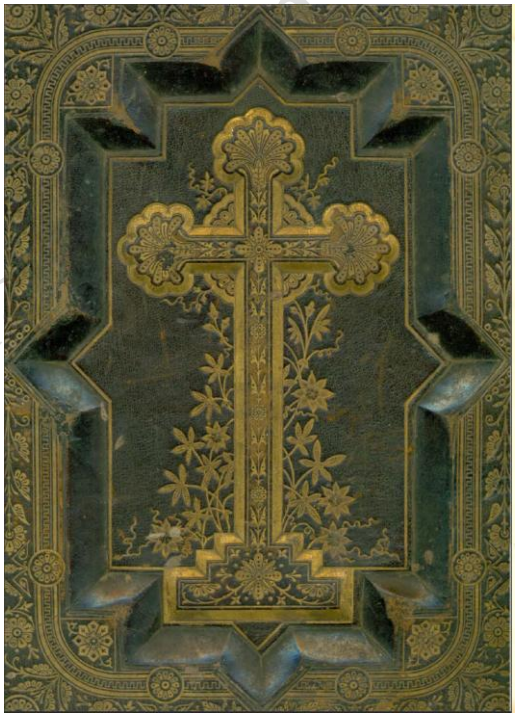
The Douai Bible is, for your information, much older than the most common Bible in France, which is the Louis Segond Bible (1910), and it is 2 years older than the King James Version, which dates from 1611 (moreover, the latter clearly mentions in its preface that it is partly inspired by the translation of the Douai Bible).

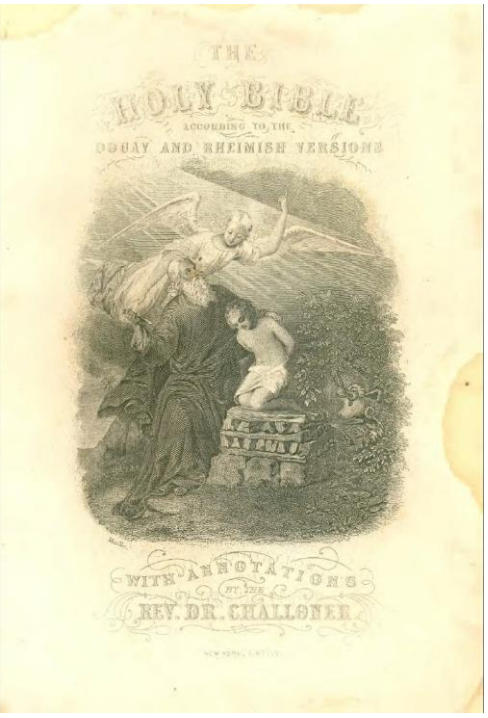
Below is the cover page and the first page of a Douai Bible from 1853 in English (can easily be found on Internet):

https://archive.org/details/douay-rheims-bible-with-haydock-commentary-complete

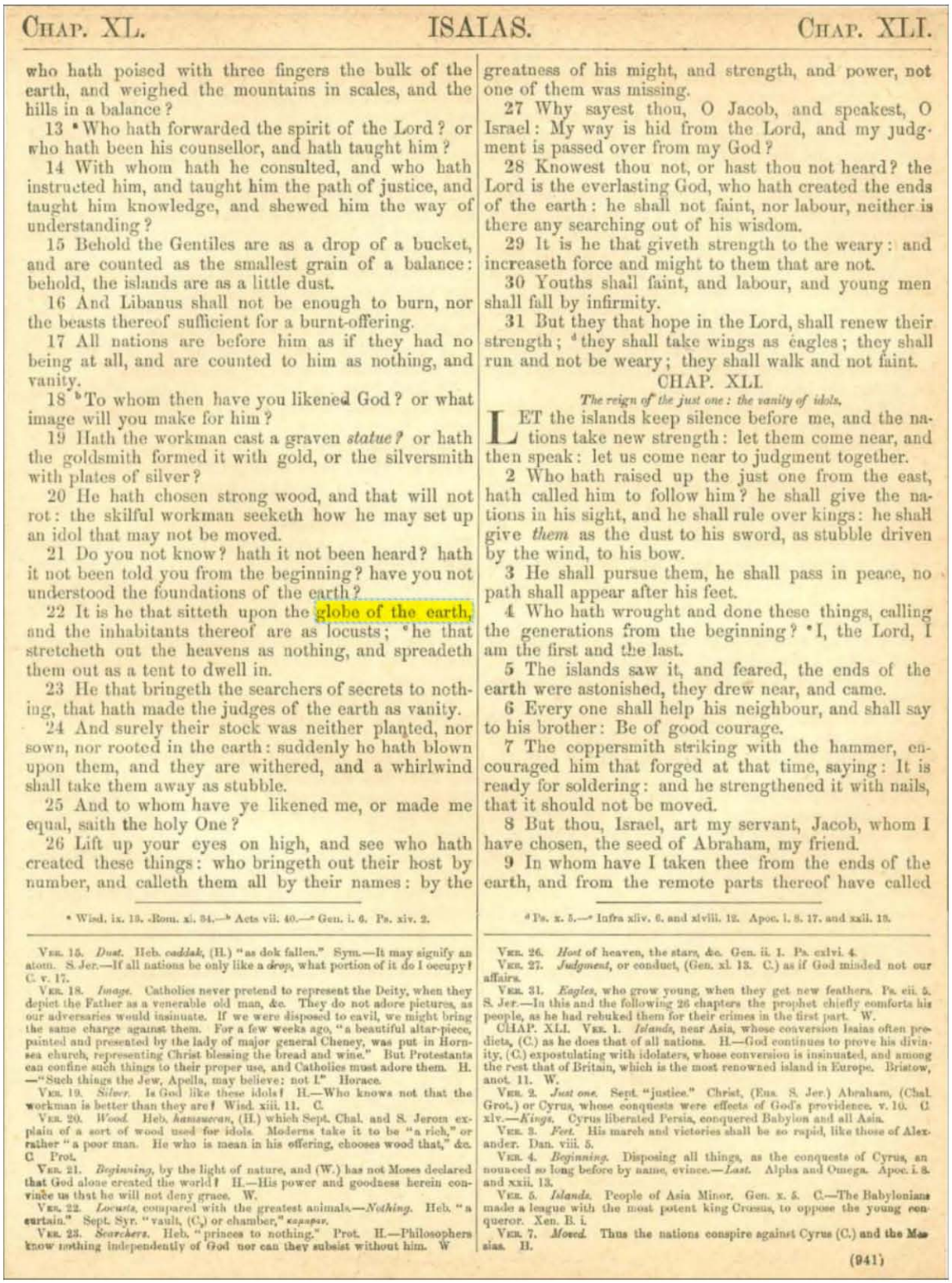
But also here (said to be from 1582):

https://archive.org/details/1582DouaiRheimsDouayRheimsFirstEdition1Of31609OldTestament/





We find in Isaiah 40:22 an explicit mention and description that the Bible is a globe:



CHAP. XL. ISAIAS. CHAP. XLI.

who hath poised with three fingers the bulk of the earth, and weighed the mountains in scales, and the hills in a balance?

13 [a]Who hath forwarded the spirit of the Lord? or who hath been his counsellor, and hath taught him?

14 With whom hath he consulted, and who hath instructed him, and taught him the path of justice, and taught him knowledge, and shewed him the way of understanding?

15 Behold the Gentiles are as a drop of a bucket, and are counted as the smallest grain of a balance: behold, the islands are as a little dust.

16 And Libanus shall not be enough to burn, nor the beasts thereof sufficient for a burnt-offering.

17 All nations are before him as if they had no being at all, and are counted to him as nothing, and vanity.

18 [b]To whom then have you likened God? or what image will you make for him?

19 Hath the workman cast a graven *statue?* or hath the goldsmith formed it with gold, or the silversmith with plates of silver?

20 He hath chosen strong wood, and that will not rot: the skilful workman seeketh how he may set up an idol that may not be moved.

21 Do you not know? hath it not been heard? hath it not been told you from the beginning? have you not understood the foundations of the earth?

22 It is he that sitteth upon the globe of the earth, and the inhabitants thereof are as locusts; [c]he that stretcheth out the heavens as nothing, and spreadeth them out as a tent to dwell in.

23 He that bringeth the searchers of secrets to nothing, that hath made the judges of the earth as vanity.

24 And surely their stock was neither planted, nor sown, nor rooted in the earth: suddenly he hath blown upon them, and they are withered, and a whirlwind shall take them away as stubble.

25 And to whom have ye likened me, or made me equal, saith the holy One?

26 Lift up your eyes on high, and see who hath created these things: who bringeth out their host by number, and calleth them all by their names: by the greatness of his might, and strength, and power, not one of them was missing.

27 Why sayest thou, O Jacob, and speakest, O Israel: My way is hid from the Lord, and my judgment is passed over from my God?

28 Knowest thou not, or hast thou not heard? the Lord is the everlasting God, who hath created the ends of the earth: he shall not faint, nor labour, neither is there any searching out of his wisdom.

29 It is he that giveth strength to the weary: and increaseth force and might to them that are not.

30 Youths shall faint, and labour, and young men shall fall by infirmity.

31 But they that hope in the Lord, shall renew their strength; [d]they shall take wings as eagles; they shall run and not be weary; they shall walk and not faint.

CHAP. XLI.

The reign of the just one: the vanity of idols.

LET the islands keep silence before me, and the nations take new strength: let them come near, and then speak: let us come near to judgment together.

2 Who hath raised up the just one from the east, hath called him to follow him? he shall give the nations in his sight, and he shall rule over kings: he shall give *them* as the dust to his sword, as stubble driven by the wind, to his bow.

3 He shall pursue them, he shall pass in peace, no path shall appear after his feet.

4 Who hath wrought and done these things, calling the generations from the beginning? [a]I, the Lord, I am the first and the last.

5 The islands saw it, and feared, the ends of the earth were astonished, they drew near, and came.

6 Every one shall help his neighbour, and shall say to his brother: Be of good courage.

7 The coppersmith striking with the hammer, encouraged him that forged at that time, saying: It is ready for soldering: and he strengthened it with nails, that it should not be moved.

8 But thou, Israel, art my servant, Jacob, whom I have chosen, the seed of Abraham, my friend.

9 In whom have I taken thee from the ends of the earth, and from the remote parts thereof have called

[a] Wisd. ix. 13. Rom. xi. 34.—[b] Acts vii. 40.—[c] Gen. i. 6. Ps. xiv. 2.

[d] Ps. x. 5.—[a] Infra xliv. 6. and xlviii. 12. Apoc. i. 8. 17. and xxii. 13.

Ver. 15. *Dust.* Heb. *caddak,* (H.) "as dok fallen." Sym.—It may signify an atom. S. Jer.—If all nations be only like a *drop,* what portion of it do I occupy? C. v. 17.

Ver. 18. *Image.* Catholics never pretend to represent the Deity, when they depict the Father as a venerable old man, &c. They do not adore pictures, as our adversaries would insinuate. If we were disposed to cavil, we might bring the same charge against them. For a few weeks ago, "a beautiful altar-piece, painted and presented by the lady of major general Cheney, was put in Hornsea church, representing Christ blessing the bread and wine." But Protestants can confine such things to their proper use, and Catholics must adore them. H. —"Such things the Jew, Apella, may believe: not I." Horace.

Ver. 19. *Silver.* Is God like these idols? H.—Who knows not that the workman is better than they are? Wisd. xiii. 11. C.

Ver. 20. *Wood.* Heb. *hamsuccan,* (H.) which Sept. Chal. and S. Jerom explain of a sort of wood used for idols. Moderns take it to be "a rich," or rather "a poor man. He who is mean in his offering, chooses wood that," &c. C. Prot.

Ver. 21. *Beginning,* by the light of nature, and (W.) has not Moses declared that God alone created the world? H.—His power and goodness herein convince us that he will not deny grace. W.

Ver. 22. *Locusts,* compared with the greatest animals.—*Nothing.* Heb. "a curtain." Sept. Syr. "vault, (C.) or chamber," καμαρα.

Ver. 23. *Searchers.* Heb. "princes to nothing." Prot. H.—Philosophers know nothing independently of God nor can they subsist without him. W.

Ver. 26. *Host* of heaven, the stars, &c. Gen. ii. 1. Ps. cxlvi. 4.

Ver. 27. *Judgment,* or conduct, (Gen. xl. 13. C.) as if God minded not our affairs.

Ver. 31. *Eagles,* who grow young, when they get new feathers. Ps. ciii. 5. S. Jer.—In this and the following 26 chapters the prophet chiefly comforts his people, as he had rebuked them for their crimes in the first part. W.

CHAP. XLI. Ver. 1. *Islands,* near Asia, whose conversion Isaias often predicts, (C.) as he does that of all nations. H.—God continues to prove his divinity, (C.) expostulating with idolaters, whose conversion is insinuated, and among the rest that of Britain, which is the most renowned island in Europe. Bristow, anot. 11. W.

Ver. 2. *Just one.* Sept. "justice." Christ, (Eus. S. Jer.) Abraham, (Chal. Grot.) or Cyrus, whose conquests were effects of God's providence. v. 10. C. xlv.—*Kings.* Cyrus liberated Persia, conquered Babylon and all Asia.

Ver. 3. *Feet.* His march and victories shall be so rapid, like those of Alexander. Dan. viii. 5.

Ver. 4. *Beginning.* Disposing all things, as the conquests of Cyrus, announced so long before by name, evince.—*Last.* Alpha and Omega. Apoc. i. 8. and xxii. 13.

Ver. 5. *Islands.* People of Asia Minor. Gen. x. 5. C.—The Babylonians made a league with the most potent king Croesus, to oppose the young conqueror. Xen. B. i.

Ver. 7. *Moved.* Thus the nations conspire against Cyrus (C.) and the Messias. H.

(941)

Or in the foonotes of Matthew:

10 And Jesus knowing it, said to them: Why do you trouble this woman? for she hath wrought a good work upon me.

11 For the poor you have always with you: but me you have not always.

12 For she, in pouring this ointment upon my body, hath done it for my burial.

13 Amen, I say to you, wheresoever this gospel shall be preached in the whole world, that also which she hath done, shall be told for a memory of her.

14 [a]Then went one of the twelve, who was called Judas Iscariot, to the chief priests:

15 And he said to them: What will you give me, and I will deliver him unto you? But they appointed him thirty pieces of silver.

16 And from thenceforth he sought opportunity to betray him.

17 [b]And on the first day of the azymes, the disciples came to Jesus, saying: Where wilt thou that we prepare for thee to eat the Pasch?

18 But Jesus said: Go ye into the city to a certain man, and say to him: The master saith: My time is near at hand, with thee I make the Pasch with my disciples.

19 And the disciples did as Jesus had appointed them, and they prepared the Pasch.

20 [c]Now when it was evening, he sat down with his twelve disciples.

21 And whilst they were eating, he said: Amen, I say to you, [d]that one of you is about to betray me.

[a] Mark xiv. 10. Luke xxii. 3.—[b] Mark xiv. 12. Luke xxii. 7.

[c] Mark xiv. 17. Luke xxii. 14.—[d] John xiii. 21.

V.—S. Matt. and S. Mark mention the disciples. But such of them as spoke, were persuaded to what they said either by Judas's words, or by their feeling and affection for the poor; but the only motive of Judas was avarice. S. Thos. Aquin.

VER. 10. *Why do you trouble this woman?* By this, our Saviour teaches us, that we are not to expect the more perfect acts of virtue from persons still novices, or young in the service of God. He takes the part of the woman, and speaks in her behalf; that the tender bud of her faith might not be blasted, but that her virtues might be watered with tenderness, and thus assisted to produce greater fruit for the future. When, therefore, we behold any good action done, though some imperfection may creep in with it, still ought we to behold it with kindness, and assist it to bring forth more perfect acts for the time to come. S. Chrys. hom. lxxxi.

VER. 11–12. *Me you have not*, or will not have *always*, in this visible manner. —*She . . hath done it for my burial.* S. Mark (xiv. 8.) says, *She hath prevented the time to anoint me*, which is done at burials, for my time of being buried will be in a few days. Wi.—*Me you have not always*; viz. in a visible manner, as when conversant here on earth: and as we have the poor, whom we may daily assist and relieve. Ch.—Or, he is not always corporally present with us, except in the persons of the poor, whom our Saviour commands us to receive or assist; promising to reward us in the same manner, as if we had conferred the same charity on himself. This saying does not contradict what he afterwards said: *behold, I am with you all days, even to the consummation of the world*; (C. xxviii. 20.) because in the former, he only speaks of his corporal presence, but in the latter text, of his spiritual presence and constant assistance. Dion. Carth.

VER. 13. *That also which she hath done.* The exploits of kings and emperors are no longer remembered. The actions of those who have built cities, raised fortresses, carried on wars, and erected trophies of their victories; who have subdued nations, dictated laws to thousands, and raised statues to their own honour, have passed into oblivion; and many of their names are long ago forgotten. But when a poor simple woman, in the house of a leper, in the presence of twelve men, pours out her ointment; her good work is rehearsed after the lapse of so many ages, in every part of the habitable globe. S. Chrys. hom. lxxxi.

VER. 14. *The chief priests* were then assembled; Judas, the disciple, who chiefly regretted the expense of the perfumes that had been used on his Lord and Master, at the feast of Bethania, and wished for an opportunity to make good the loss, went to the chief priests, saying:

VER. 15. *What will you give me?* The impious wretch did not betray his divine Master out of fear, but out of avarice. Of all passions the love of sordid lucre is the most vile; and the avaricious soul does not fear to plunge herself into the bottom of hell, for a trifling gain. There is no vestige of honour or justice, or probity, remaining in the heart of that man who is possessed with the love of base lucre; whose god is his money. The perfidious Judas, inebriated with this passion, while he thirsts after gain, sells with the most foolish impiety his Lord and his Master. S. Leo the great.—He sells him for the paltry consideration of thirty pieces of silver, about £3 15s. the price of a common slave. See Exod. xxi. 32. It is probable that even the obdurate heart of Judas would not have betrayed his Master to the Jews, had he not expected that Jesus would escape from their hands on this occasion, as he had done at Nazareth, and in the temple.

THE PASCHAL SUPPER.

VER. 17. *The first day of the azymes*; unleavened bread. S. Mark (xiv. 12.) adds, *when they sacrificed the Pasch*: and S. Luke (xxii. 7.) says, *And the day of the unleavened bread came; on which it was necessary that the Pasch* (i. e. the Paschal lamb) *should be killed.* From hence it follows, that Christ sent his apostles that very day (the 14th day of the month of Nisan) on which, in the evening, or at night, *the Pasch* was to be eaten; and which was to be with unleavened bread. It is true, the 15th *day* of that month is called (Ex. xii. 1.) *the first day of unleavened bread*: but we must take notice, that the Jews began their feasts, or festivals, from sunset of the evening before; and consequently on the evening of the 14th day of the moon; at which time there was to be no leavened bread in any of their houses. This shews that Christ eat the *Pasch*, or *Paschal lamb*, after sunset. And when the Paschal supper was over, he consecrated the blessed Eucharist, in unleavened bread, as the Latin Church doth. There are two or three difficulties relating to this matter in S. John, of which in their proper places. Wi.—There were four passovers during Christ's public ministry. The 1st, was after the marriage feast of Cana, in the 31st year of Jesus, and the 779th from the foundation of Rome. To derive *pascha* from the Greek, πάσχειν, *to suffer*, is a mistake, as S. Austin observes; tract. lv. in Joan. It is certainly taken from the Hebrew, and signifies *a passing by*, or *passing over*: 1st, because the children of Israel passed in haste on that night out of the land of Egypt; 2d, because the angel, who on that night killed all the first-born of the Egyptians, seeing the doors of the Israelites stained with the blood of the paschal lamb, passed by all theirs untouched; 3d, because that was a figure of our Saviour passing out of this life to his eternal Father. Yet it must be observed that this same word, *pascha*, or passover, is used sometimes for the *paschal lamb*, that was sacrificed; (Luke xxii. 7.) elsewhere, for the first day of the paschal feast and solemnity, which lasted seven days; (Mat. xxvi. 2. Ezech. xlv. 21.) for the sabbath-day, which occurred within the seven days of the solemnity; (John xix. 14.) and also for all the sacrifices made during the seven days' feast. The Passover was the most solemn rite of the old law. When God ordered the Israelites to sprinkle the blood of the lamb upon their door-posts, it was solely with a view of signifying, that the blood of the true Lamb was to be the distinctive mark of as many as should be saved. Every thing was mysterious and prophetical. A bone of the lamb was not to be broken; and they broke not the arms or legs of Jesus Christ, on the cross. The lamb was to be free from blemish; to express the perfect sanctity of Jesus Christ, the immaculate Lamb of God. The paschal lamb was to be sacrificed and eaten; because Christ was to suffer and die for us: and unless we eat his flesh, we shall have no life in us. The door-posts of the Israelites were to be sprinkled with blood, that the destroying angel might pass over them; for with the blood of Christ our souls are to be purified, that sin and death may not prevail against us. In every house was eaten a whole lamb; and Christ, at communion, is received whole and entire by every faithful soul.—The manner in which it was to be eaten, shews the proper dispositions for Christians when they receive the blessed sacrament. The roasting by fire, expresses divine charity; the unleavened bread, sincerity, truth, and a good conscience; the bitter herbs, repentance and contrition for sin; the girded loins and shod feet, the restraint upon our passions and lusts, and a readiness to follow the rules of the gospel; the staff, our mortal pilgrimage, and that having no lasting dwelling here, we should make the best of our way to our true country, the heavenly Chanaan.—On this day the passover was to be eaten, at least by a part of the people, according to S. Matt. S. Mark, and S. Luke; i. e. according to some, by the Galileans; for, according to S. John, it appears that the priests, and the Jews properly so called, such as dwelt in Judea, did not immolate it till the next day. John xiii. 1, xviii. 28, and xix. 14. V.—But we have here again to remark, that the Jews began their day from sunset of the preceding day.

VER. 18. *To a certain man*, whom SS. Mark and Luke call, *the good man of the house*, or *master of the house*. When S. Mat. therefore says, *a certain man*, he seems to do it for brevity's sake; as no one ever speaks to his servants thus, *go to a certain man*. The evangelist, therefore, after giving our Saviour's words, *go ye into a certain city*, he adds as from himself, *to a certain man*, to inform us that there was a particular man to whom Jesus sent his disciples. S. Austin.—In Greek, τὸν δεῖνα; in Hebrew, *Peloni*; words that express a person whose name is either not known, or is wished to be kept secret. Jans.

VER. 19. *And they prepared* what was necessary, a lamb, wild lettuce, and unleavened bread. V.

VER. 20. *When it was evening.*† S. Luke says, *when the hour was come*, which was at the latter evening, after sunset. The time of killing and sacrificing the lamb was, according to the 12th of Exodus, to be *between the two evenings*; (see Mar. xiv. 15.) so that we may reasonably suppose, that Christ sent some of his apostles on Thursday, in the afternoon, to perform what was to be done, as to the killing and sacrificing of the lamb, and then to bring it away: and he eat it with his disciples after sunset.—*He sat down*, &c. Lit. *laid down*, is a leaning or lying posture. Some pretend, from this circumstance, that he eat not the paschal lamb that year, because it was to be eaten *standing*, according to the law. But they might stand at the paschal lamb, and eat the rest of the supper on couches; as it was then the custom. Wi.—We must not hence suppose that he transgressed the law. He first eat the Pasch according to the Mosaic rite, standing, and then *sat down* to supper. S. Chrys. hom. lxxxii.

VER. 22. *And they being very much troubled.* There were three motives for this great sorrow in the disciples: 1st, because they saw their innocent and dear Master was so soon to be taken from them, and delivered up to a most cruel and ignominious death; 2d, because each of them was afraid lest, through human

Or also in the footnotes of the first epistle of S. Peter, the Apostle:

for sinners to make a confession to a layman, not that they then looked upon it as a sacrament, but only that they hoped God would accept of their private devotions and humiliation, when they could not have a priest to administer the sacraments to them. It is needless to mention authors in the following ages. S. Greg. (Sacramentarium. fer. 5. in Cœna Dni.) describes the ceremony of blessing oil to be used in the anointing of the sick. Theodore, made archbishop of Canterbury, an. 668, among other decrees, ordains that sick persons receive the holy unction, set down by S. James. The Capitularia of Charles the great, say that no one, when about to depart out of this world, ought to want the anointing of the sacrament of oil. The same is ordained in a council of Chalons, an. 813, can. 48; by a council at Aix la Chapelle, an. 850, can. 5; by the council of Mayence, an. 847, can. 26, &c. Now since we find this anointing made use of as a sacrament at least from the fourth age, let our adversaries tell us when this anointing prescribed by S. James was left off, and when and how it came to be taken up again. They have no manner of proofs for either; and yet we have a right, as the authors of the annotations on the Rhem. Testam. observe, to demand clear and convincing proofs in this case, when the Scripture seems so clear for us and against them. Dr. Fulk affirms boldly, that *this anointing was never to this day received in the Greek Church as a sacrament.* This only shews how little credit is to be given to him. He might have found great reason to doubt of his bold assertion, since neither Photius, in the ninth age, nor Michael Cerularius, in the eleventh, ever objected this difference betwixt their Greek and the Latin Church, at a time when they reckoned up even the most minute differences either in doctrine or discipline, so as to find fault with the Latins for shaving their beards. He might have found it by what happened at the time of the council of Lyons, in the thirteenth age, when the pope, in his letter to the emperor of Constantinople, wrote that the Latin Church, and all in communion with him, acknowledged seven sacraments, which the Greeks never blamed. He might have observed the same when the Greeks and Armenians came to an union in the council of Florence, in the fifteenth age. The same Dr. Fulk, who wrote about the year 1600, could scarce be ignorant of the ill success the *Augsbourg confession* met with among the Greeks, to whom, when the Lutherans had sent copies of their faith and of their reformation, Jeremy, the patriarch of Constantinople, with a synod of the Greeks, condemned their articles, and among other points, declared that they held "in the orthodox Catholic Church seven divine sacraments," the same as in the Latin Church, *baptism . . . and the holy oil.* Had Dr. Fulk lived a little longer, he must have been more and more ashamed to find other Greek synods condemning him and all the said reformers. For when Cyrillus Lucaris, advanced to the see of Constantinople by the interest of the French Calvinists, began to favour and support the doctrine of the Calvinists, the Greeks in several synods under their patriarchs, (an. 1639, 1642, 1671, and 1672) condemned Cyril and the new doctrine of the said reformers, and expressly declared that they held *seven sacraments.* See M. Arnauld, tom. iii. Perpetuité de la Foy; and the dissertations of M. Le Brun, tom. iii. p. 34, and 572, dissert. 12, where he shews that all the churches of the East, and all the Christian churches of the world, though separated from the communion and subordination to the Pope, agree with the Latin Church, as to the sacrifice of the Mass, as to the real presence of Christ in the Eucharist, and as to the seven sacraments. Wi.—If, with holy Scripture, we must allow that charitable persons on earth may prove instrumental, under God, to their neighbour's salvation, why are we to deny this to the saints in heaven, whose charity for man is much greater?

* V. 7. Temporaneum et Serotinum. In most Greek MSS. ὑετὸν πρόϊμον καὶ ὄψιμον, pluviam priorem et posteriorem.

† V. 10. Exemplum accipite, exitus mali, et laboris, et patientiæ, κακοπαθείας καὶ μακροθυμίας. There is nothing in the Greek for laboris, which the Latic interpreter may have added to express the full sense.

‡ V. 14–15. Infirmatur, ἀσθενεῖ τις; infirmum, κάμνοντα, laborantem; allevabit, ἐγερεῖ, suscitabit.

§ V. 20. Origen, in hom. ii, in Levit. (p. 68. Ed. Par. an. 1574) where he numbers the different ways by which sins are remitted in the new law, and speaking of penance, says, In quo impletur et illud quod Apostolus dicit, Si quis autem infirmatur, vocet presbyteros ecclesiæ.

‖ Ibid. S. Chrys. ἰερεῖς . . . ἔχουσιν ἐξουσίαν, habent potestatem.

¶ Ibid. Innoc. I. Pœnitentibus istud infundi non potest, quia genus est Sacramenti, nam quibus reliqua Sacramenta negantur, quomodo unum genus putatur concedi? By chrisma, Innocent I. understands, oleum ad unguendum.

THE

FIRST EPISTLE OF S. PETER,

THE APOSTLE.

THIS first Epistle of S. Peter, though brief, contains much doctrine concerning faith, hope, and charity, with divers instructions to all persons of every state and condition. The apostle commands submission to rulers and superiors, and exhorts all to the practice of a virtuous life, in imitation of Christ. This epistle is written with such apostolical dignity, as to manifest the supreme authority with which its writer, the prince of the apostles, had been invested by his Lord and Master, Jesus Christ. He wrote it at Rome, which figuratively he calls Babylon, about fifteen years after our Lord's ascension. Ch.—S. Peter, otherwise called Simon, son of John or Jonas, was from Bethsaida, a city of Galilee. He was married, and lived at Capharnaum, and was employed with his brother Andrew, as fishermen, when our Lord called them. S. Peter on every occasion testified a more than usual zeal for his Master, and hence our Lord shewed him a very particular and very marked attention. He would have Peter present at his transfiguration; (Luke ix. 28.) and at another time declared that he was a rock, upon which he would build his Church, against which the gates of hell should never prevail. Mat. xvi. 18. Although S. Peter had the misfortune or weakness to deny Jesus Christ in his passion, our Lord, after his resurrection, gave him fresh proofs of his regard. Mat. xvi. 7. He continued him in his primacy over all, and appointed him in the most explicit manner visible head of his Church, when thrice asking Peter: "lovest thou me more than these?" and S. Peter as often answering, Christ said to him: "feed my lambs, feed my sheep." John xxi. 15.—This epistle was always received in the Church as *canonical*, and as written by S. Peter, prince of the apostles. It is commonly agreed that it was written from Rome, which S. Peter calls Babylon, (C. v. 13.) and directed to those in the provinces of Pontus, Galatia, &c. (v. 1.) who were before Jews or Gentiles, and had been converted to the Christian faith. It is certain this letter was not written till after the true believers had the name of Christians. C. iv. 16. Many think it was written before the year 49; but this is not certain. Others judge not till after the year 60, and some not till a short time before he wrote his second epistle. See Tillem. t. i. Art. 31. on S. Pet. and tom. ii. on S. Mark, p. 89. The main design is to confirm the new converts in the faith of Christ, with divers instructions to a virtuous life. Wi.—Grotius, Erasmus, and Estius, discover in this epistle, a strength and majesty worthy the prince of the apostles. Est autem epistola profecto digna Apostolorum Principe, plena authoritatis et majestatis Apostolicæ: verbis parca, sententiis referta.

CHAP. I.

He gives thanks to God for the benefit of our being called to the true faith, and to eternal life; into which we are to enter by many tribulations. He exhorts to holiness of life, considering the holiness of God, and our redemption by the blood of Christ.

PETER, an apostle of Jesus Christ, to the strangers dispersed through Pontus, Galatia, Cappadocia, Asia, and Bithynia, elect,

2 According to the foreknowledge of God, the Father, unto the sanctification of the Spirit, unto the obedience and sprinkling of the blood of Jesus Christ: Grace unto you, and peace be multiplied.

3 *Blessed be the God and Father of our Lord Jesus Christ, who according to his great mercy hath regenerated us unto a lively hope, through the resurrection of Jesus Christ from the dead,

* 2 Cor. i. 3. Ephes. i. 3.

CHAP. I. VER. 1. *Peter, an apostle of Jesus Christ, to the strangers dispersed.* Lit. *of the dispersion;* i. e. to the Jews or Gentiles now converted, who lived dispersed in those countries, chosen or elected* according to the foreknowledge and eternal decrees of God unto *the sanctification of the spirit.* Wi.—*Asia* is taken for one of the four quarters of the globe, or for Asia Minor, or for that province of Asia Minor of which Ephesus is the capital. It is in this latter sense it appears here to be understood, since Pontus, Galatia, Cappadocia, and Bithynia are also contained in the provinces of Asia Minor. V.

VER. 2. *Unto the obedience and sprinkling of the blood of Jesus Christ;* i. e. to be saved by the merits of his death and passion. Wi.—All the three divine Persons conspire in the salvation of the elect. The Father as principle of their election, by his eternal prescience; the Son as victim for their sins, and the

Islam confirms the globe

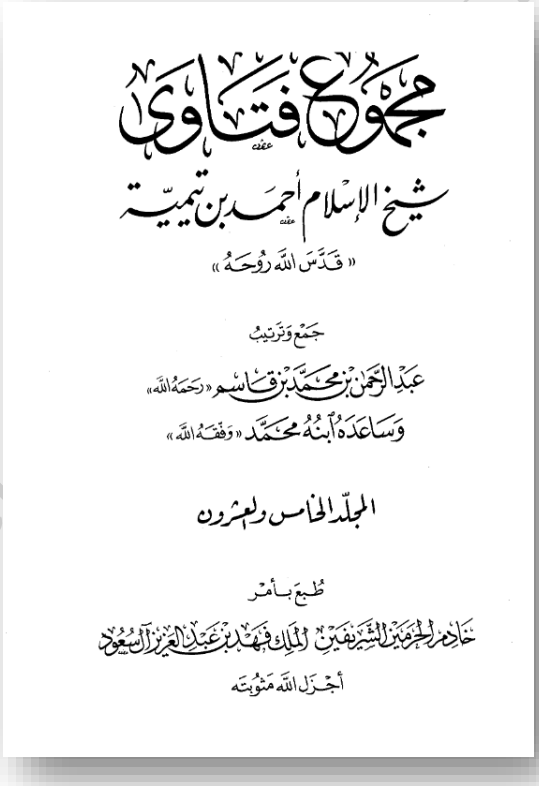
Several scholars and theologians from different periods of Islam confirm that the Earth is a globe. Let's look at some well-known cases in Hanbali Sunni Islam and Zahiri Sunni Islam (years are given, as usual, in relation to the Gregorian solar calendar).

Note: Generally speaking, however, archaeologists and historians agree that Jews and Christians did not know that the Earth was a sphere when they founded their respective faiths. Similarly, if we count the number of specialists in Islam who claim the Earth is flat versus those who claim it is a sphere, there is generally a clear tendency toward the flat Earth theory.

(#308) Hanbali school of thought: consensus of scholars (Sunni school)

According to the Hanbali school (which is one of the four major schools of Sunnism along with Hanafi, Maliki, Shafi'i): "*The Earth is round by consensus of the scholars.*" (Majmu' al-Fatawa, Volume 25, p. 195).

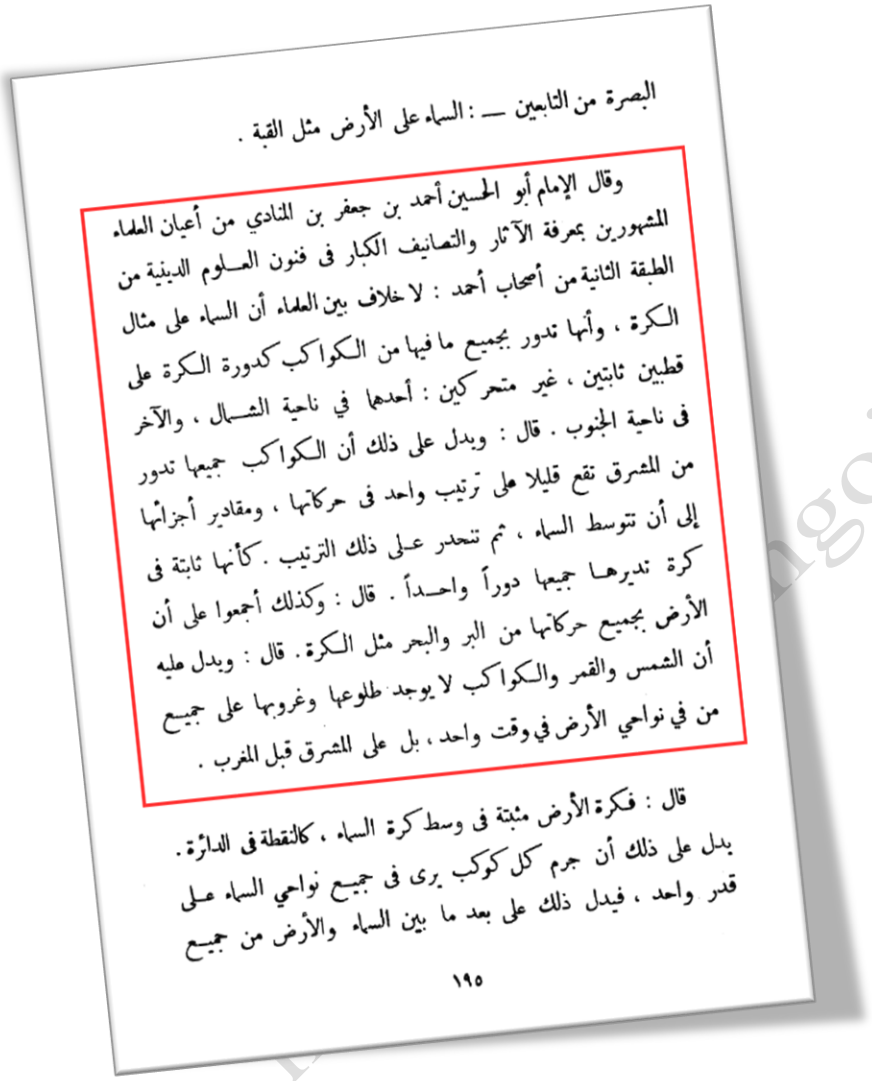
Indeed, we have the following in their work:


مجموع فتاوى
شيخ الإسلام أحمد بن تيمية
«قدس الله روحه»
جمع وترتيب
عبد الرحمن بن محمد بن قاسم «رحمه الله»
وساعده ابنه محمد «وفقه الله»
المجلد الخامس والعشرون
طبع بأمر
خادم الحرمين الشريفين الملك فهد بن عبد العزيز آل سعود
أجزل الله مثوبته

Available here:

https://ibnaldayni.wordpress.com/wp-content/uploads/2021/05/mfsiaitm25.pdf

We have indeed on page 195:



البصرة من التابعين — : السماء على الأرض مثل القبة .

وقال الإمام أبو الحسين أحمد بن جعفر بن المنادي من أعيان العلماء المشهورين بمعرفة الآثار والتصانيف الكبار في فنون العلوم الدينية من الطبقة الثانية من أصحاب أحمد : لا خلاف بين العلماء أن السماء على مثال الكرة ، وأنها تدور بجميع ما فيها من الكواكب كدورة الكرة على قطبين ثابتين ، غير متحركين : أحدهما في ناحية الشمال ، والآخر في ناحية الجنوب . قال : ويدل على ذلك أن الكواكب جميعها تدور من المشرق تقع قليلا على ترتيب واحد في حركاتها ، ومقادير أجزائها إلى أن تتوسط السماء ، ثم تنحدر على ذلك الترتيب . كأنها ثابتة في كرة تديرها جميعها دوراً واحداً . قال : وكذلك أجمعوا على أن الأرض بجميع حركاتها من البر والبحر مثل الكرة . قال : ويدل عليه أن الشمس والقمر والكواكب لا يوجد طلوعها وغروبها على جميع من في نواحي الأرض في وقت واحد ، بل على المشرق قبل المغرب .

قال : فكرة الأرض مثبتة في وسط كرة السماء ، كالنقطة في الدائرة . يدل على ذلك أن جرم كل كوكب يرى في جميع نواحي السماء على قدر واحد ، فيدل ذلك على بعد ما بين السماء والأرض من جميع

١٩٥

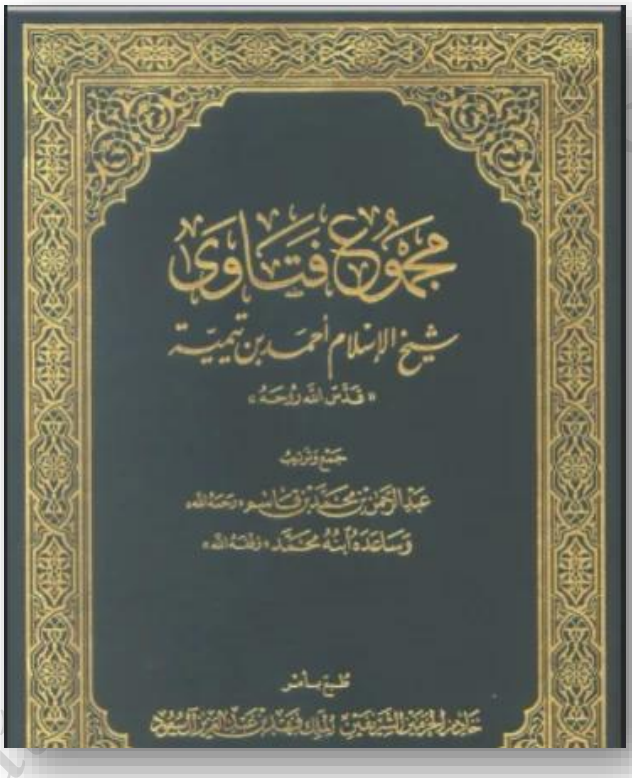
Here is the full translation:

"*Imam Abu al-Hussein Ahmad ibn Ja'far ibn al-Munadi, one of the eminent scholars renowned for his knowledge of major works and contributions to the arts of religious sciences, and one of the second class of Ahmad's companions, stated: There is no disagreement among the scholars that the heavens are like a sphere, and that they rotate with all the planets like a sphere rotating on two fixed poles. They do not move: one is in the north and the other in the south. He said: This is indicated by the fact that all the planets rotate from the east and descend slightly in the same order in their movements and the magnitude of their parts until they reach the middle of the heavens, then they descend in that order. It is as if he were stationary inside a ball, causing it to rotate suddenly. He stated: "Similarly, they unanimously agree that the Earth, with all its movements, whether terrestrial or marine, is like a ball.*"

(#309) Ibn Taymiya (1263/Hanbali school)

Taqi al-Din Ahmad ibn Taymiyya (born January 22, 1263, in Harran, present-day Turkey, and died September 26, 1328, in Damascus, Syria) was a 13th-century Muslim theologian and jurist, an influential figure within the Hanbali school of thought. His era was marked by conflicts between the Mamluks and the Mongols, and he attempted to organize a jihad against the latter, whom he accused of disbelief. Distinguished by his rejection of what he considered innovations in religious practice, and rejecting both al-Ghazali and Ibn Arabi, as well as all the philosophers (falasifa), his disagreements with the leading religious figures of his time led to his imprisonment on several occasions. He died in prison.

In the following work:



We have:

اعلم أن «الأرض» قد اتفقوا على أنها كروية الشكل وهي في الماء المحيط بأكثرها؛ إذ اليابس السدس وزيادة بقليل، والماء أيضاً مقبب من كل جانب للأرض، والماء الذي فوقها بينه وبين السماء كما بيننا وبينها مما يلي رؤوسنا،

The translation of the boxed passage is:

"They agreed that 'The Earth' is spherical."

In another of his books:

كان كذلك امتنع كونه تعالى في الحيز والجهة بيان الأول أنه إذا حصل خسوف قمري فإذا سألنا سكان أقصى المشرق عن ابتدائه قالوا إنه حصل في أول الليل وإذا سألنا سكان أقصى المغرب قالوا إنه حصل في آخر الليل فعلمنا أن أول الليل في أقصى المشرق هو بعينه آخر الليل في أقصى المغرب وذلك يوجب كون الأرض كرة وإنما قلنا إن الأرض لما كانت كرة امتنع كون الخالق في شيء من الأحياز وذلك أن الأرض إذا كانت كرة فالجهة التي هي فوق بالنسبة إلى سكان أهل المشرق هي تحت بالنسبة إلى سكان أهل المغرب وعلى العكس فلو اختص الباري بشيء من الجهات لكان تعالى في جهة التحت بالنسبة إلى بعض الناس وذلك باطل بالاتفاق بيننا وبين الخصم فثبت أنه يمتنع كونه مختصًا بالجهة والكلام على هذا أن يقال هذا الذي ذكره مبني على أن الأرض مستديرة والأفلاك مستديرة وهذا القدر قد ينازعه فيه

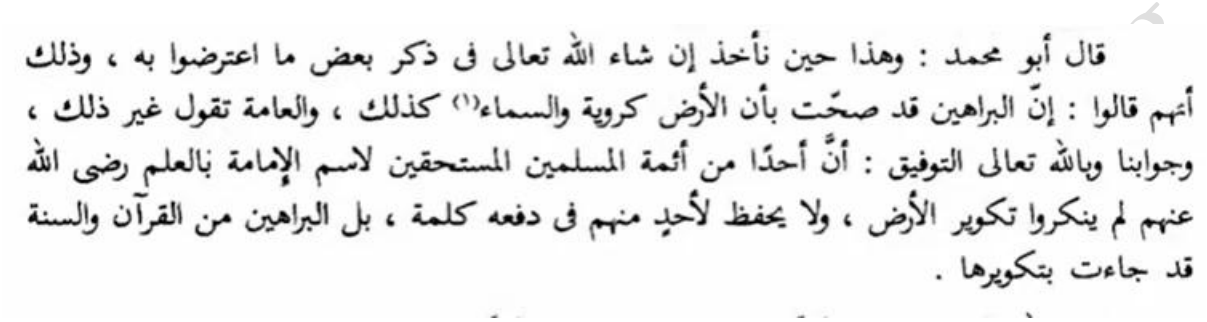
Here is the translation of the underlined portion:

"The Earth must be a sphere."

translation into english

(#310) Abou Muhammed Ibn Hazm (994/Zahiri school)

Ibn Hazm (Arabic: Abū Muḥammad ʿAlī ibn Aḥmad ibn Saʿīd ibn Ḥazm) (November 7, 994/384 AH, Córdoba – August 15, 1064/456 AH, Montíjar or Niebla (Taifa of Seville)) was a Muslim poet, historian, jurist, philosopher, and theologian. He further developed the Zahirite doctrine and applied its methods to the entire field of Quranic studies. He is the author of the famous *The Ring of the Dove*. He was educated within the circle of the Umayyad dynasty of Córdoba, a dynasty to which he remained steadfastly loyal. He experienced multiple imprisonments and periods of exile throughout his life.



قال أبو محمد : وهذا حين نأخذ إن شاء الله تعالى فى ذكر بعض ما اعترضوا به ، وذلك أنهم قالوا : إنّ البراهين قد صحّت بأن الأرض كروية والسماء(١) كذلك ، والعامة تقول غير ذلك ، وجوابنا وبالله تعالى التوفيق : أنّ أحدًا من أئمة المسلمين المستحقين لاسم الإمامة بالعلم رضى الله عنهم لم ينكروا تكوير الأرض ، ولا يحفظ لأحدٍ منهم فى دفعه كلمة ، بل البراهين من القرآن والسنة قد جاءت بتكويرها .

Here is the translation:

“Abu Muhammad said: It is at this point that we shall—God willing—address some of their objections; namely, **their claim that while evidence has established the Earth to be spherical**—and the heavens (1) likewise—ordinary people maintain the contrary.

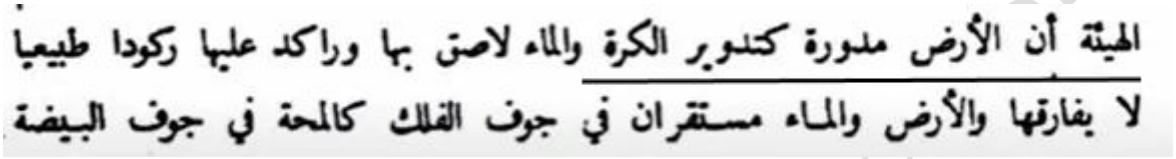
Our response—and may God Almighty grant us success—is that none of the Muslim Imams deserving of that title by virtue of their knowledge ever denied the sphericity of the Earth; indeed, evidence from the Qur’an and the Sunnah has demonstrated its spherical nature...”

translation into english

(#311) Muhammad al Idrisi (1100/Sunni school)

Al Idrissi, Al-Idrīsī, Edrisi or Sharif Al-Idrisi; full name Abu Abdallah Muhammad Ibn Muhammad Ibn Abdallah Ibn Idriss al-Qurtubi al-Hassani (Arabic: أبو عبد الله محمد ابن محمد ابن عبد الله ابن ادريس القرطبي الحسني); also known as Dreses and sometimes nicknamed "the Arab from Nubia"was an Arab-Andalusian explorer, geographer, botanist, and physician, born possibly in Ceuta (then known as Sebtanote) around 1100. He grew up in North Africa and Al-Andalus, studied in Córdoba under the Almoravid Empire, explored much of the Mediterranean, and also traveled to Europe. He is believed to have died around 1165 or 1175 in Sicily or Ceuta. He belonged to the Idrisid Sharifian family.

We have the following text from him:


الهيئة أن الأرض مدورة كتدوير الكرة والماء لاصق بها وراكد عليها ركودا طبيعيا
لا يفارقها والأرض والماء مستقران في جوف الفلك كالمحة في جوف البيضة

Here is the translation of the underlined part:

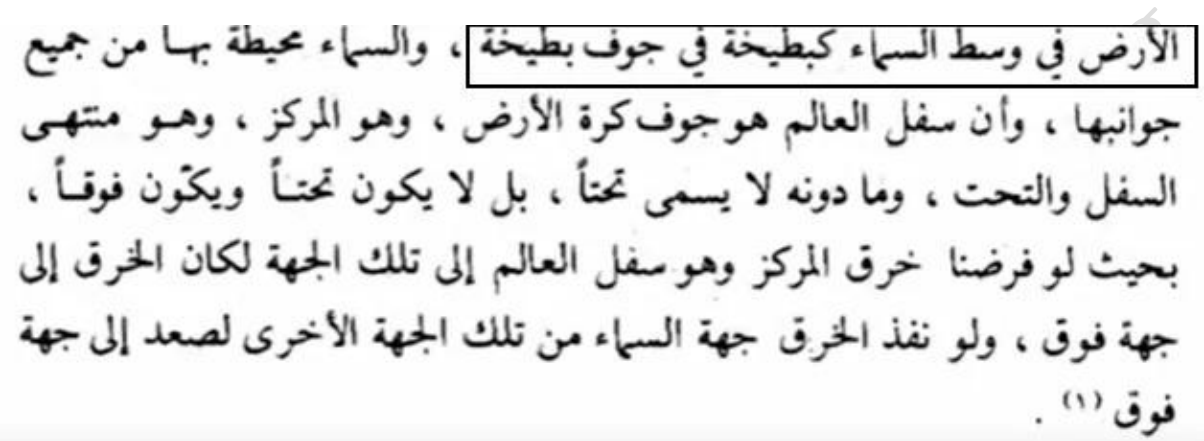
"The Earth is as spherical as a ball."

translation into english pending

(#312) Shams ad-Dīn adh-Dhahabī (1274/Sunni school)

Shams ad-Dīn adh-Dhahabī (1274–1348) was a theologian, Islamic historian, and Hadith scholar who lived in Damascus during the early Mamluk Sultanate period. He belonged to the Athari school of Sunni Islam (Atharism is a theological school of thought that emphasizes the literal acceptance of religious texts—particularly the Quran and Hadiths—without philosophical or metaphorical interpretation).

In one of his texts, we find:



الأرض في وسط السماء كبطيخة في جوف بطيخة ، والسماء محيطة بها من جميع جوانبها ، وأن سفل العالم هو جوف كرة الأرض ، وهو المركز ، وهو منتهى السفل والتحت ، وما دونه لا يسمى تحتاً ، بل لا يكون تحتاً ويكون فوقاً ، بحيث لو فرضنا خرق المركز وهو سفل العالم إلى تلك الجهة لكان الخرق إلى جهة فوق ، ولو نفذ الخرق جهة السماء من تلك الجهة الأخرى لصعد إلى جهة فوق (١) .

The translation of the boxed section of which yields:

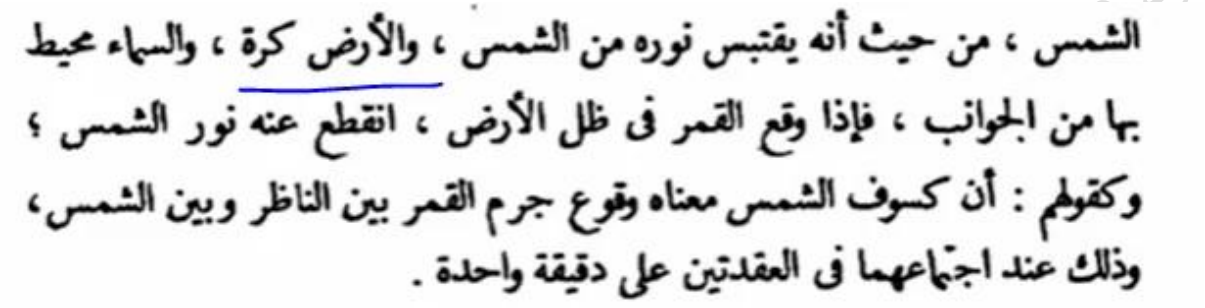
"The Earth in the heavens is like a melon inside a watermelon."

translation into engl

(#313) Al-Ghazāli (1111/Sunni school)

Abu Hamid Muhammad ibn Muhammad Al-Ghazali al-Tusi al-Nisaburi (1058–1111) is known in the West by the Latinized names Algazel or Algazelus. A Muslim philosopher, theologian, logician, jurist, and mystic of Persian origin, he is a major figure in Muslim thought. He belonged to the Sunni branch of Islam. Al-Ghazali is particularly renowned for integrating Sufism (Islamic mysticism) into Islamic orthodoxy, notably through his seminal work, "*Iḥyā' 'Ulūm al-Dīn*" (The Revival of the Religious Sciences).

In one of his texts, we find:



الشمس ، من حيث أنه يقتبس نوره من الشمس ، والأرض كرة ، والسماء محيط
بها من الجوانب ، فإذا وقع القمر فى ظل الأرض ، انقطع عنه نور الشمس ؛
وكقولهم : أن كسوف الشمس معناه وقوع جرم القمر بين الناظر وبين الشمس ،
وذلك عند اجتماعهما فى العقدتين على دقيقة واحدة .

So, if we translate the underlined part:

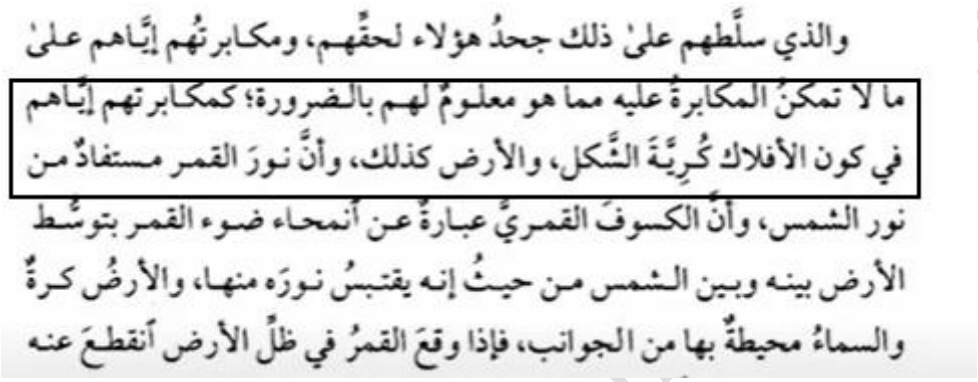
"The Earth is a sphere."

translation into englis

(#314) Ibn al-Qayyim (1292/Sunni school)

Abū ʻAbd Allāh Shams al-Dīn Muḥammad ibn Abī Bakr ibn Ayyūb ibn Saʻd ibn Ḥarīz ibn Makkī Zayn al-Dīn al-Zurʻī al-Dimashqī al-Ḥanbalī—better known as Ibn Qayyim al-Jawziyyah, or sometimes simply Ibn Qayyim (though "Ibn al-Qayyim" is more correct)—was a renowned Sunni Muslim imam, scholar (ʻālim), jurist (faqīh), mufti, and poet associated with the Ḥanbalī school of thought (madhhab). He was born on 7 Ṣafar 691 AH (January 29, 1292) in Damascus (Mamluk Sultanate of Egypt) and died on September 15, 1350, in the same city.

In one of his texts, we find:


والذي سلَّطهم علىٰ ذلك جحدُ هؤلاء لحقِّهم، ومكابرتُهم إيَّاهم علىٰ
ما لا تمكنُ المكابرةُ عليه مما هو معلومٌ لهم بالضرورة؛ كمكابرتهم إيَّاهم
في كون الأفلاك كُرِيَّةَ الشَّكل، والأرض كذلك، وأنَّ نورَ القمر مستفادٌ من
نور الشمس، وأنَّ الكسوفَ القمريَّ عبارةٌ عن انمحاء ضوء القمر بتوسُّط
الأرض بينه وبين الشمس من حيثُ إنه يقتبسُ نورَه منها، والأرضُ كرةٌ
والسماءُ محيطةٌ بها من الجوانب، فإذا وقعَ القمرُ في ظلِّ الأرض انقطعَ عنه

Here is the translation:

"*What led them to act this way was their denial of established truths and their arrogance regarding matters of which they were not necessarily aware—such as their objection to the fact that celestial bodies are spherical, just like the Earth; that moonlight derives from sunlight; and that a lunar eclipse occurs when the Earth—positioned between the Moon and the Sun—obscures the Moon's light (since the Moon relies on the Sun for illumination,* ***and the Earth is a sphere*** *surrounded by the heavens, the Moon is cut off from that light when it falls into the Earth's shadow).*"

In short, he says there are three things no one can deny: the Earth is round, moonlight comes from the Sun, and—finally—how a solar eclipse works.

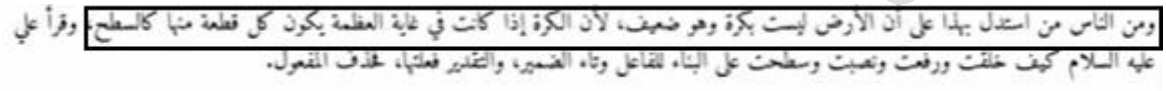
translation in progress

(#315) Fakhr al-Din al-Razi (1149/Sunni scholar)

Abou Abdullah Mohammad ibn Omar ibn al-Husayn at-Taymi al-Bakri at-Tabaristani Fakhr al-Din al-Razi (in arabic: أبو عبدالله محمد بن عمر بن الحسن بن الحسين بن علي التيمي البكري فخرالدين الرازى طبرستانى) was a Persian theologian and philosopher born in Ray (Seljuk Empire) in 1150 and who died in 1210 in Herat (Khwarazmian Empire, in present-day Afghanistan). A Sunni Muslim of the Shafi'i school, he taught Islamic theology. He also studied philosophy, medicine, astronomy, and logic. He authored numerous works in both Arabic and Persian, the most notable being *Notes on the Principles of Religion, Compendium of the Ideas of Ancient and Modern Scholars, Philosophers*, and *Theologians*, and *The Great Commentary on the Quran* (also known as *The Keys to the Unseen*).

He belonged to the Ash'ari school of Sunni Islam. Ash'arism is a school of theology that seeks to harmonize Islamic faith with reason and philosophy, while rejecting some of the more extreme interpretations of Islamic philosophy (falsafa).

In one of his texts, we find:


ومن الناس من استدل بهذا على أن الأرض ليست بكرة وهو ضعيف، لأن الكرة إذا كانت في غاية العظمة يكون كل قطعة منها كالسطح وقرأ علي عليه السلام كيف خلقت ورفعت ونصبت وسطحت على البناء للفاعل وتاء الضمير، والتقدير فعلتها، فحذف المفعول.

Here is the translation of the boxed section:

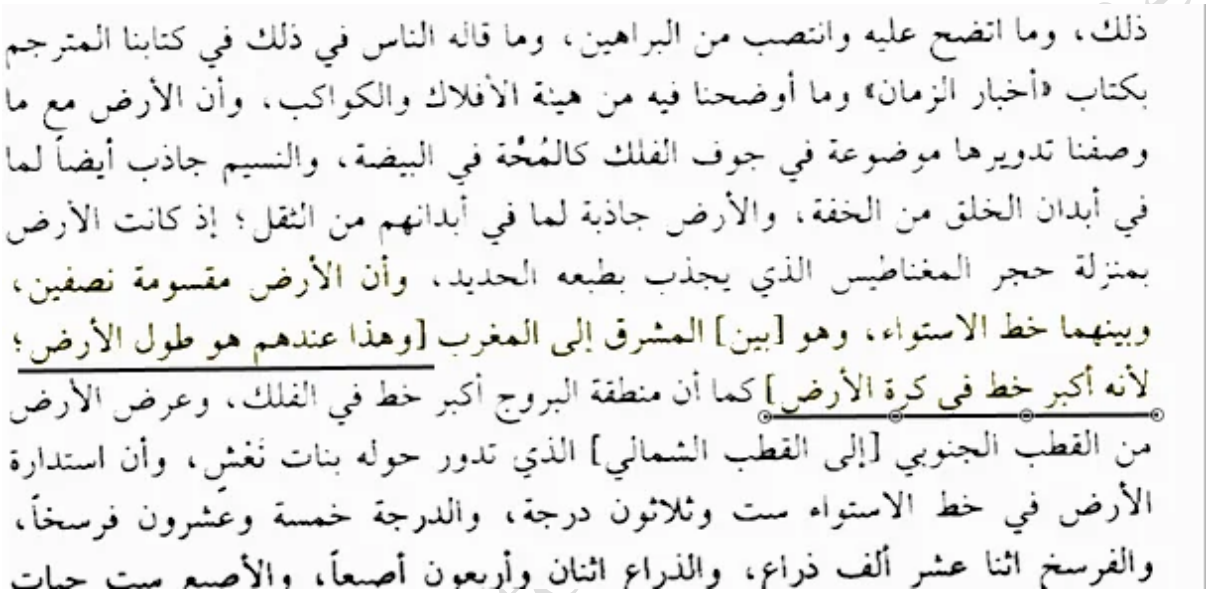
"*Some people have used this verse to suggest that the Earth is flat. This argument is weak and insignificant, because when a sphere is sufficiently large, any part of it resembles a flat surface.*"

translation into english ongoing

(#316) Al-Masudi (896/Sunnite)

Al-Mas'ūdī (or Al-Masudi; Arabic: Abū al-Ḥasan 'Alī ibn al-Ḥusayn ibn 'Alī al-Mas'ūdī), born in Baghdad in the late 9th century and died in Fustat in September 956, was an Arab encyclopedist and polymath who lived during the height of the classical Islamic era. His work *Murūj adh-dhahab wa-ma'ādin al-jawhar* (Meadows of Gold and Mines of Precious Stones) remained the standard reference for geographers and historians writing in Arabic or Persian until the mid-15th century.

In one of his texts, we find:



ذلك، وما اتضح عليه وانتصب من البراهين، وما قاله الناس في ذلك في كتابنا المترجم
بكتاب «أخبار الزمان» وما أوضحنا فيه من هيئة الأفلاك والكواكب، وأن الأرض مع ما
وصفنا تدويرها موضوعة في جوف الفلك كالمُحّة في البيضة، والنسيم جاذب أيضاً لما
في أبدان الخلق من الخفة، والأرض جاذبة لما في أبدانهم من الثقل؛ إذ كانت الأرض
بمنزلة حجر المغناطيس الذي يجذب بطبعه الحديد، وأن الأرض مقسومة نصفين،
وبينهما خط الاستواء، وهو [بين] المشرق إلى المغرب [وهذا عندهم هو طول الأرض؛
لأنه أكبر خط في كرة الأرض] كما أن منطقة البروج أكبر خط في الفلك، وعرض الأرض
من القطب الجنوبي [إلى القطب الشمالي] الذي تدور حوله بنات نَعْش، وأن استدارة
الأرض في خط الاستواء ست وثلاثون درجة، والدرجة خمسة وعشرون فرسخاً،
والفرسخ اثنا عشر ألف ذراع، والذراع اثنان وأربعون أصبعاً، والأصبع ست حبات

Here is the translation:

*"This—along with what has become clear and established through evidence, and what people have said on the subject in our book known as *Akhbar al-Zaman*, and our explanations therein regarding the shape of the spheres and planets—reveals that the Earth, despite the rotation we described, is situated within the sphere like the yolk of an egg; furthermore, the air exerts a pull on the bodies of created beings, and the Earth exerts a pull due to the heaviness of their bodies. For the Earth is like a lodestone that naturally attracts iron; it is divided into two halves separated by the equator—lying between East and West—which represents, according to them, the length of the Earth. This is because it is the greatest line on Earth, just as the zodiac is the greatest line in astronomy; the width of the Earth extends from the South Pole to the North Pole—around which the 'Daughters of Na'ash' revolve—and the Earth's rotation at the equator measures thirty-six degrees, with one degree equaling twenty-five *farsakhs*, one *farsakh* equaling twelve thousand cubits, and one cubit equaling forty-two finger-widths..."*

(#317) Qibla

The qibla is the direction a Muslim worshipper must face to perform the ritual prayer (salat). In contemporary Islam, it corresponds to the great-circle path connecting the place of prayer to the Kaaba in the city of Mecca. In mosques, this orientation is indicated by the mihrab, a prayer niche often framed by two columns supporting an arch.

Muslims pray facing the Qibla, which can be determined from the direction of the Sun when it is directly above the Kaaba in Mecca on May 27 and 28 at 9:18 GMT, and on July 15 and 16 at 9:27 GMT. If the Sun is visible, it will indicate the direction of the Qibla.

With the flat-Earth map, the Qibla does not consistently point toward the Kaaba. Only the spherical-Earth model yields consistent results for every location on Earth—results that align with centuries of observation—proving that the Earth is a sphere!

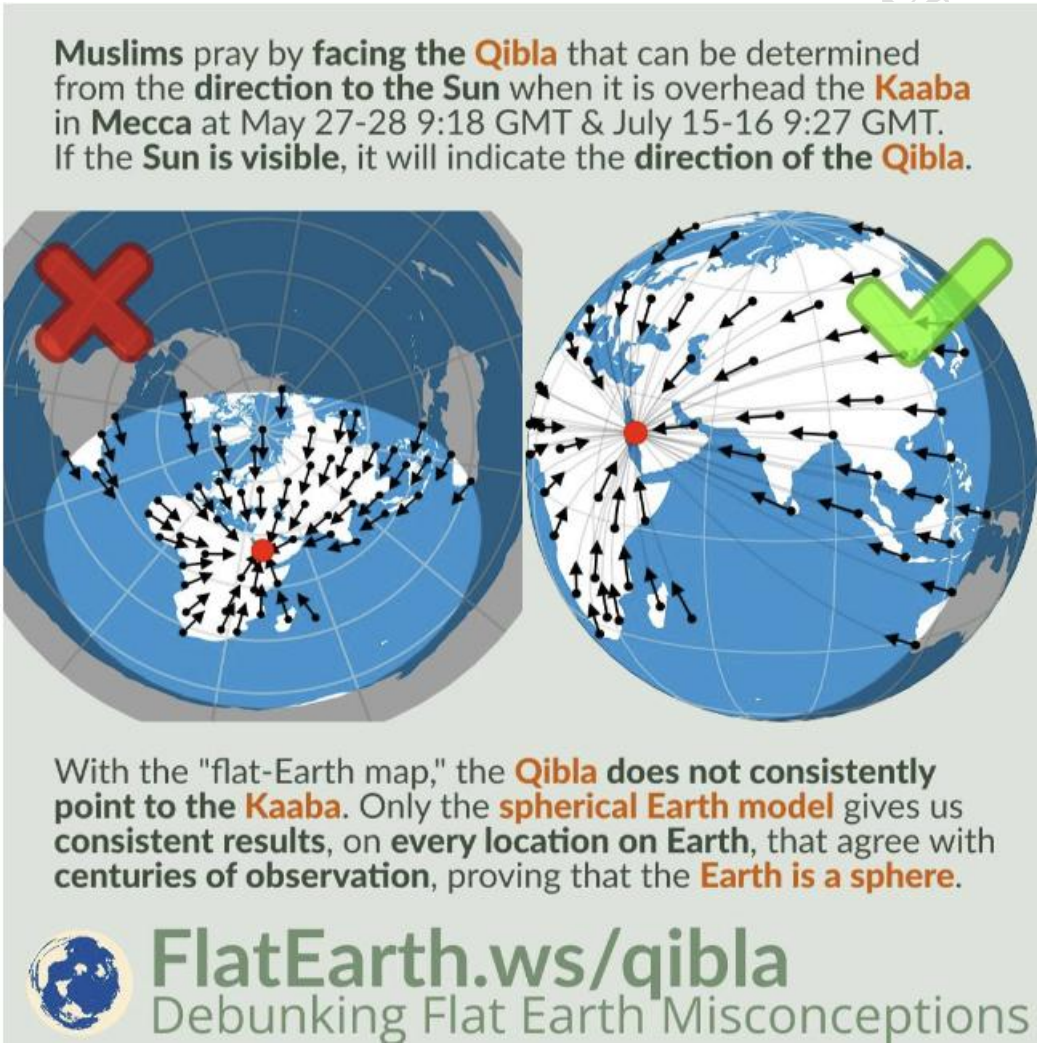
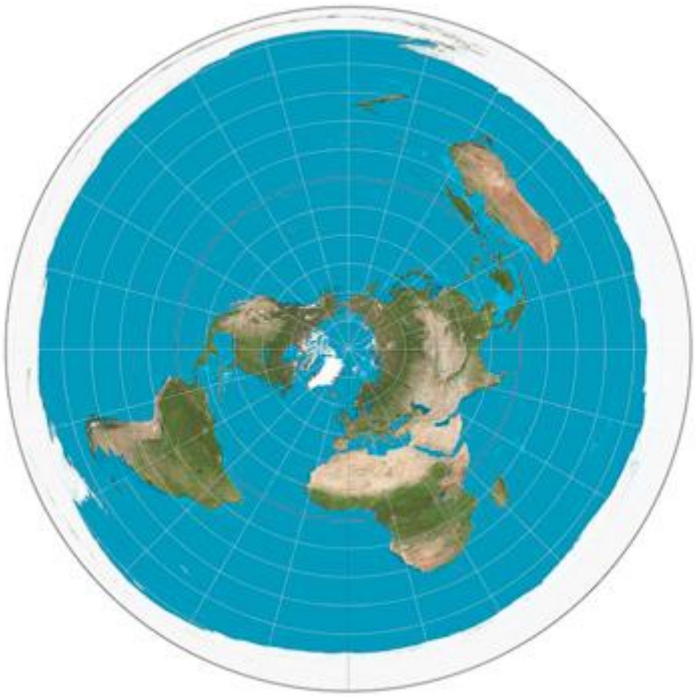
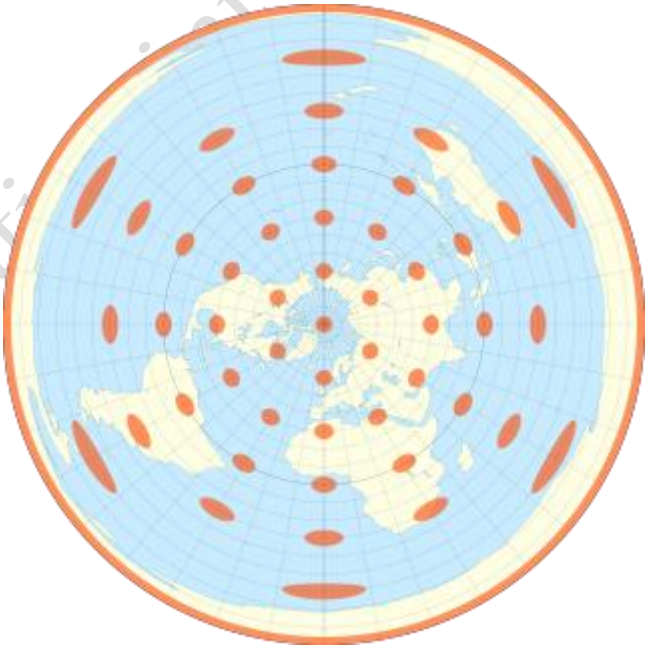

Muslims pray by facing the Qibla that can be determined from the direction to the Sun when it is overhead the Kaaba in Mecca at May 27-28 9:18 GMT & July 15-16 9:27 GMT. If the Sun is visible, it will indicate the direction of the Qibla.
With the "flat-Earth map," the Qibla does not consistently point to the Kaaba. Only the spherical Earth model gives us consistent results, on every location on Earth, that agree with centuries of observation, proving that the Earth is a sphere.
FlatEarth.ws/qibla
Debunking Flat Earth Misconceptions

Figure 164 Qibla direction on a flat Earth vs. a spherical Earth (source: FlatEarth.ws)

Since flattards are not very well-educated, they do not know that the map they use is an azimuthal equidistant projection (meaning it is an equidistant projection, but neither conformal[9] nor equal-area[10]):

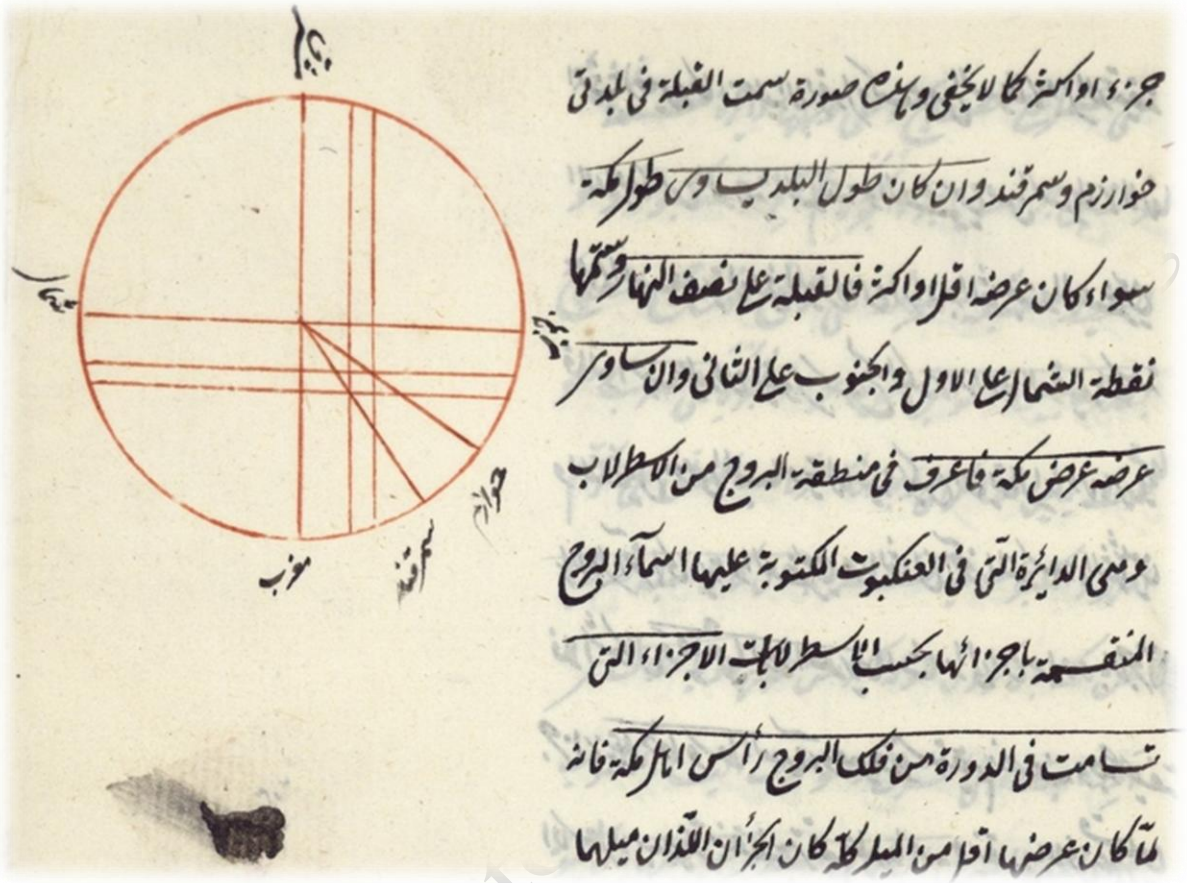


The consequence is that, for their model to work, the Sun must be distorted accordingly for many types of observations (including the Qibla), as shown in the figure below:



[9] A conformal projection is a projection that preserves angles.
[10] An authalic projection is a projection that preserves areas.

For those who might have doubts, here is a historical document in Arabic confirming that the calculation of the Qibla is based on a spherical Earth:



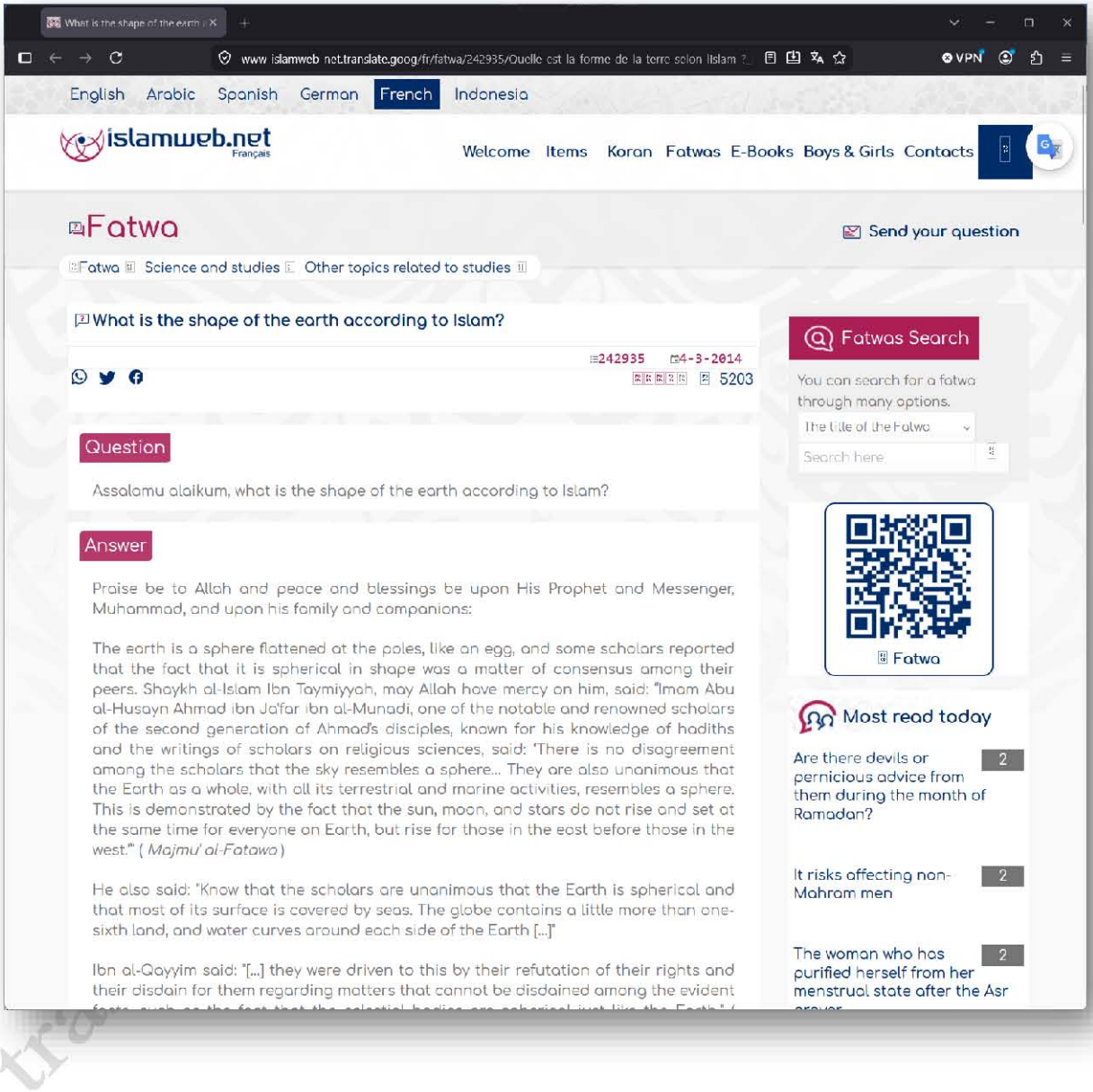
Above is a diagram illustrating the geometric method for determining the qibla. It is taken from an 18th-century Ottoman Turkish copy of the *Sharḥ al-Mulakhkhaṣ fī al-Hayʾa* ("Commentary on Mahmud al-Jaghmini's Compendium of Astronomy").

translationinu

(#318) Fatwa number 242935

There is a fatwa confirming that, in Islam, the Earth is a sphere. Here is the link to the fatwa in French:

https://www.islamweb.net/fr/fatwa/242935/Quelle-est-la-forme-de-la-terre-selon-lIslam-


English Arabic Spanish German French Indonesia
islamweb.net
Français
Welcome Items Koran Fatwas E-Books Boys & Girls Contacts
Fatwa
Send your question
Fatwa Science and studies Other topics related to studies
What is the shape of the earth according to Islam?
242935 4-3-2014
5203
Question
Assalamu alaikum, what is the shape of the earth according to Islam?
Answer
Praise be to Allah and peace and blessings be upon His Prophet and Messenger, Muhammad, and upon his family and companions:
The earth is a sphere flattened at the poles, like an egg, and some scholars reported that the fact that it is spherical in shape was a matter of consensus among their peers. Shaykh al-Islam Ibn Taymiyyah, may Allah have mercy on him, said: "Imam Abu al-Husayn Ahmad ibn Ja'far ibn al-Munadi, one of the notable and renowned scholars of the second generation of Ahmad's disciples, known for his knowledge of hadiths and the writings of scholars on religious sciences, said: 'There is no disagreement among the scholars that the sky resembles a sphere... They are also unanimous that the Earth as a whole, with all its terrestrial and marine activities, resembles a sphere. This is demonstrated by the fact that the sun, moon, and stars do not rise and set at the same time for everyone on Earth, but rise for those in the east before those in the west.'" (*Majmu' al-Fatawa*)
He also said: "Know that the scholars are unanimous that the Earth is spherical and that most of its surface is covered by seas. The globe contains a little more than one-sixth land, and water curves around each side of the Earth [...]"
Ibn al-Qayyim said: "[...] they were driven to this by their refutation of their rights and their disdain for them regarding matters that cannot be disdained among the evident
Fatwas Search
You can search for a fatwa through many options.
The title of the Fatwa
Search here
Fatwa
Most read today
Are there devils or pernicious advice from them during the month of Ramadan? 2
It risks affecting non-Mahram men 2
The woman who has purified herself from her menstrual state after the Asr 2

(#319) Catholicism (the Vatican) confirms the globe.

The Vatican Observatory, or *Specola Vaticana*, is one of the oldest active astronomical institutions in the world. Originally founded in 1578 to support the reform of the Gregorian calendar, it was entrusted to the Jesuits, who continue to oversee its scientific direction to this day.

Figure 165 Vatican Observatory on the heights of Castel Gandolfo

Historically located at Castel Gandolfo, near Rome, at the papal summer residence, it was supplemented by a second, modern site in Arizona, USA—known as the Vatican Advanced Technology Telescope (VATT)—to take advantage of better observing conditions.

Its mission encompasses scientific research in astronomy—particularly regarding galaxy formation, interplanetary dust, and the structure of the universe—as well as fostering a dialogue between science and faith through lectures and educational programs open to the public, including guided tours featuring historic telescopes, antique instruments, and astronomical artworks.

Since July 2025, the director has been Father Richard Anthony D'Souza, a Jesuit astronomer specializing in galaxy evolution.

On the observatory's official website:

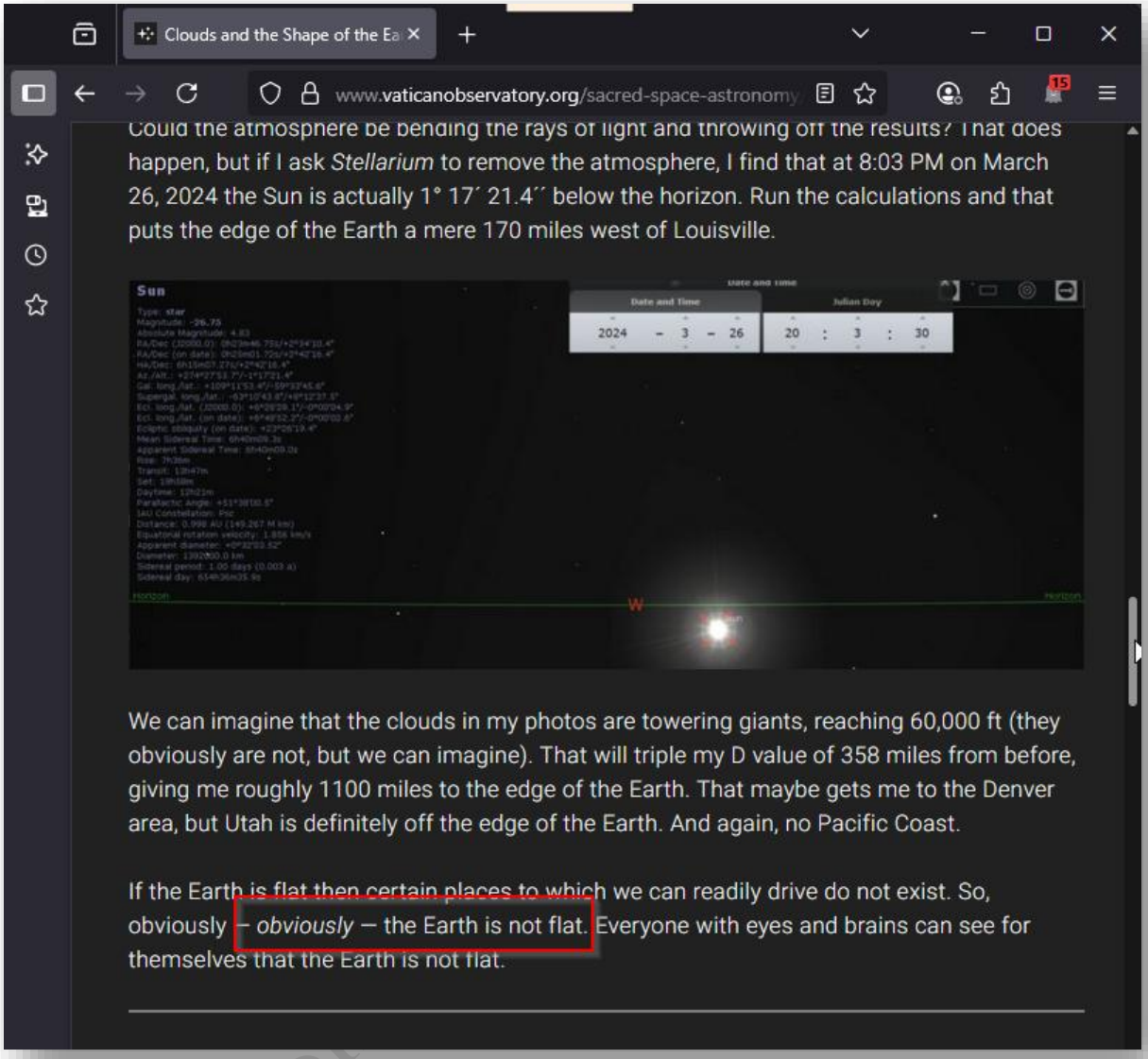
https://www.vaticanobservatory.org

Several articles therein confirm that, for the Vatican Observatory, the Earth is clearly not flat.

As for exemple :

https://www.vaticanobservatory.org/sacred-space-astronomy/clouds-and-the-shape-of-the-earth/

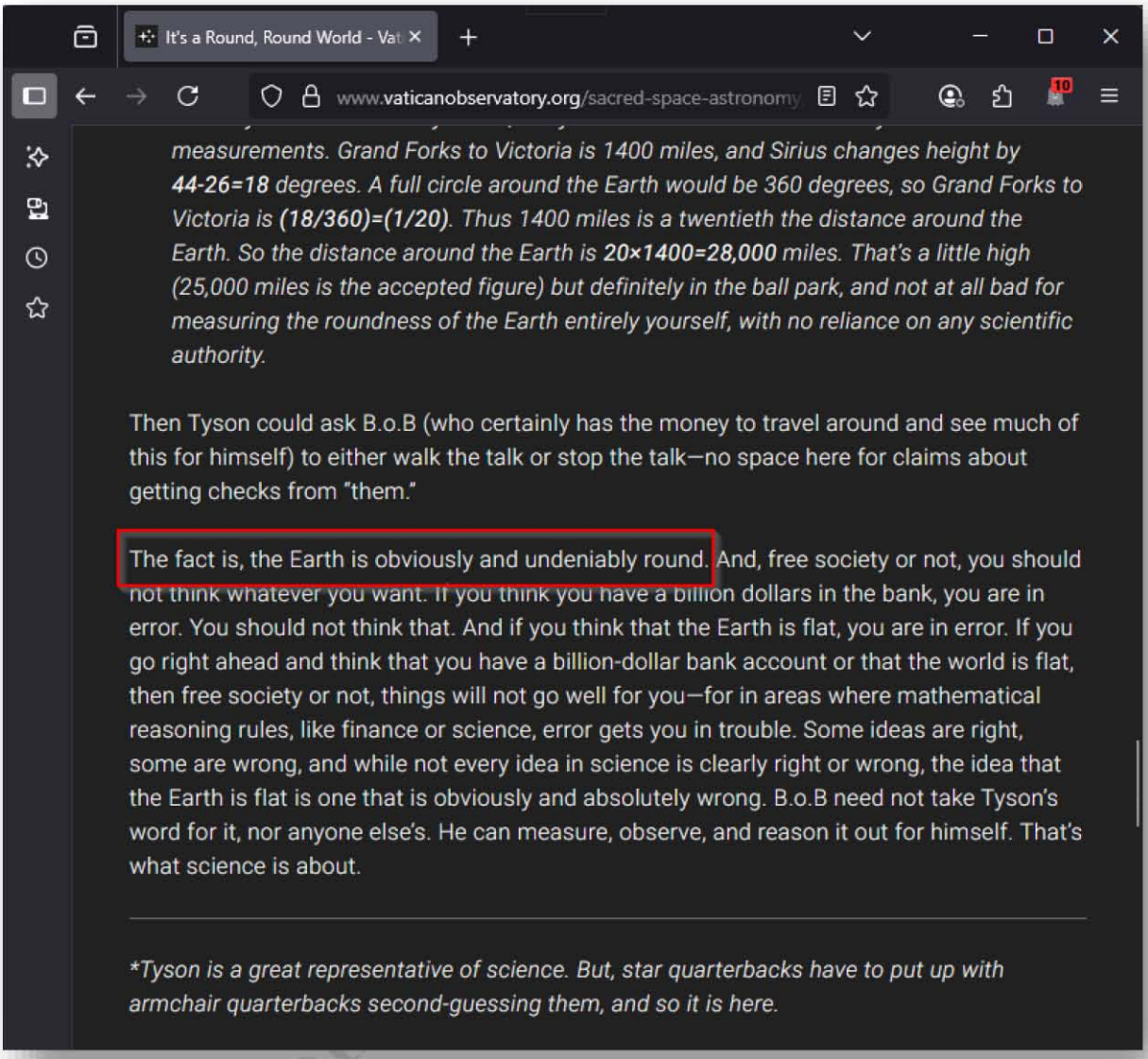
translation into


Clouds and the Shape of the Ea
www.vaticanobservatory.org/sacred-space-astronomy
Could the atmosphere be bending the rays of light and throwing off the results? That does happen, but if I ask *Stellarium* to remove the atmosphere, I find that at 8:03 PM on March 26, 2024 the Sun is actually 1° 17′ 21.4″ below the horizon. Run the calculations and that puts the edge of the Earth a mere 170 miles west of Louisville.
Sun
Date and Time
Julian Day
2024 - 3 - 26
20 : 3 : 30
We can imagine that the clouds in my photos are towering giants, reaching 60,000 ft (they obviously are not, but we can imagine). That will triple my D value of 358 miles from before, giving me roughly 1100 miles to the edge of the Earth. That maybe gets me to the Denver area, but Utah is definitely off the edge of the Earth. And again, no Pacific Coast.
If the Earth is flat then certain places to which we can readily drive do not exist. So, obviously – *obviously* – the Earth is not flat. Everyone with eyes and brains can see for themselves that the Earth is not flat.

and also :

https://www.vaticanobservatory.org/sacred-space-astronomy/its-a-round-round-world/

translation


It's a Round, Round World - Vat
www.vaticanobservatory.org/sacred-space-astronomy
measurements. Grand Forks to Victoria is 1400 miles, and Sirius changes height by **44-26=18** degrees. A full circle around the Earth would be 360 degrees, so Grand Forks to Victoria is **(18/360)=(1/20)**. Thus 1400 miles is a twentieth the distance around the Earth. So the distance around the Earth is **20×1400=28,000** miles. That's a little high (25,000 miles is the accepted figure) but definitely in the ball park, and not at all bad for measuring the roundness of the Earth entirely yourself, with no reliance on any scientific authority.
Then Tyson could ask B.o.B (who certainly has the money to travel around and see much of this for himself) to either walk the talk or stop the talk—no space here for claims about getting checks from "them."
The fact is, the Earth is obviously and undeniably round. And, free society or not, you should not think whatever you want. If you think you have a billion dollars in the bank, you are in error. You should not think that. And if you think that the Earth is flat, you are in error. If you go right ahead and think that you have a billion-dollar bank account or that the world is flat, then free society or not, things will not go well for you—for in areas where mathematical reasoning rules, like finance or science, error gets you in trouble. Some ideas are right, some are wrong, and while not every idea in science is clearly right or wrong, the idea that the Earth is flat is one that is obviously and absolutely wrong. B.o.B need not take Tyson's word for it, nor anyone else's. He can measure, observe, and reason it out for himself. That's what science is about.
*Tyson is a great representative of science. But, star quarterbacks have to put up with armchair quarterbacks second-guessing them, and so it is here.

translation

The report on artificial intelligences

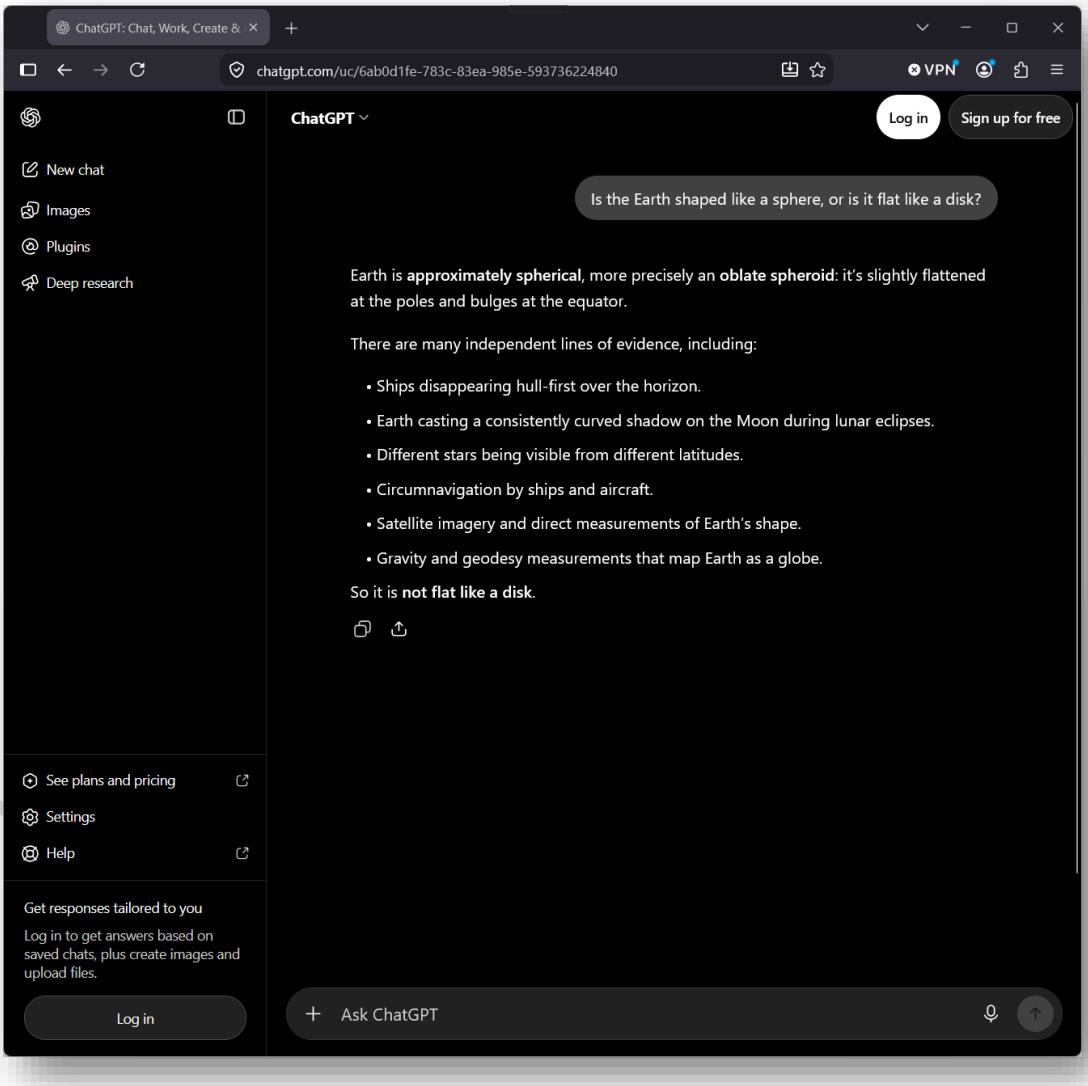
An increasing number of young people view artificial intelligence—and LLMs in particular—as reliable academic sources. Let us therefore see what the best-known LLMs to date have to say... To ensure a degree of diversity, we selected American, Chinese, Swiss and French LLMs.

Note: It is worth noting that flattards often use ChatGPT, arguing that "it is reliable and, unlike 'globists,' is not swayed by emotions..."

(#320) Open AI ChatGTP

There seems to be no doubt for artificial intelligence that the Earth is an oblate sphere and not a disk… as evidenced by the screenshot below, taken using the OpenAI ChatGPT interface on Septembre 21, 2026:

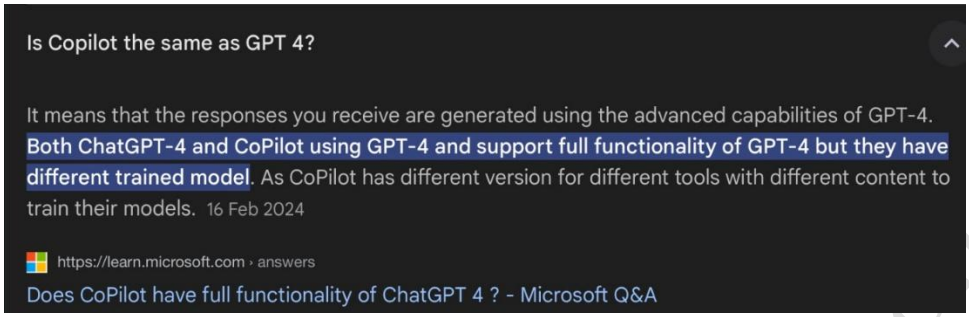
https://chatgpt.com


ChatGPT: Chat, Work, Create &
chatgpt.com/uc/6ab0d1fe-783c-83ea-985e-593736224840
VPN
ChatGPT
Log in
Sign up for free
New chat
Images
Plugins
Deep research
Is the Earth shaped like a sphere, or is it flat like a disk?
Earth is approximately spherical, more precisely an oblate spheroid: it's slightly flattened at the poles and bulges at the equator.
There are many independent lines of evidence, including:
• Ships disappearing hull-first over the horizon.
• Earth casting a consistently curved shadow on the Moon during lunar eclipses.
• Different stars being visible from different latitudes.
• Circumnavigation by ships and aircraft.
• Satellite imagery and direct measurements of Earth's shape.
• Gravity and geodesy measurements that map Earth as a globe.
So it is not flat like a disk.
See plans and pricing
Settings
Help
Get responses tailored to you
Log in to get answers based on saved chats, plus create images and upload files.
Log in
Ask ChatGPT

ongoing

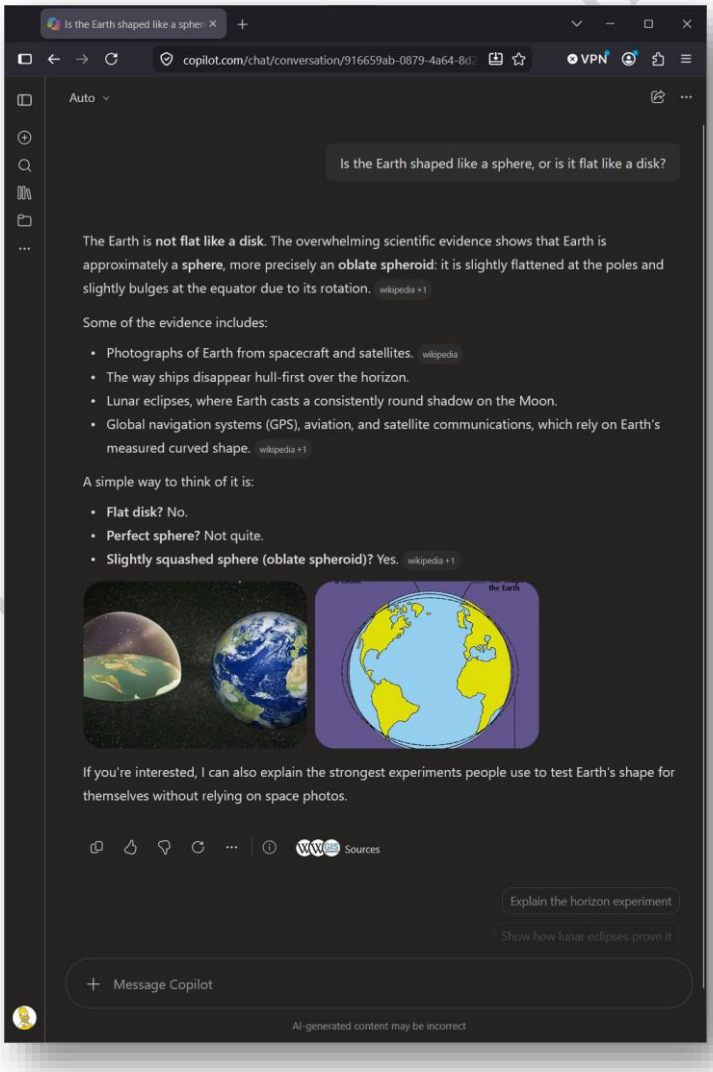
(#321) Microsoft Copilot

The same applies to Microsoft's Copilot AI: as the company itself confirms, while the algorithm is indeed based on GPT-4, it does not rely on the same training data.


Is Copilot the same as GPT 4?
It means that the responses you receive are generated using the advanced capabilities of GPT-4. Both ChatGPT-4 and CoPilot using GPT-4 and support full functionality of GPT-4 but they have different trained model. As CoPilot has different version for different tools with different content to train their models. 16 Feb 2024
https://learn.microsoft.com › answers
Does CoPilot have full functionality of ChatGPT 4 ? - Microsoft Q&A

So, when we asked the question on September 22, 2026:

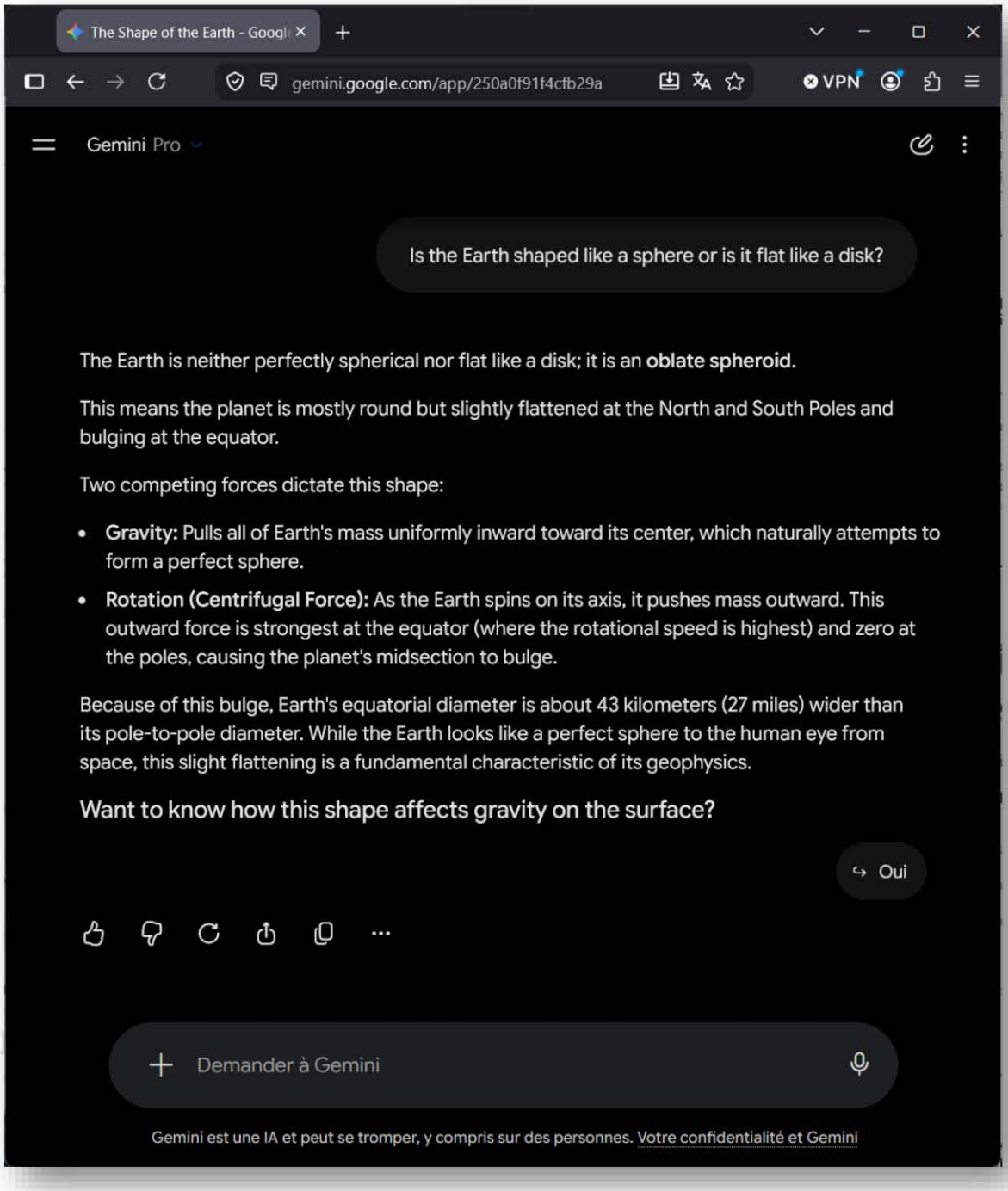
https://copilot.microsoft.com


Is the Earth shaped like a sphere, or is it flat like a disk?
The Earth is not flat like a disk. The overwhelming scientific evidence shows that Earth is approximately a sphere, more precisely an oblate spheroid: it is slightly flattened at the poles and slightly bulges at the equator due to its rotation.
Some of the evidence includes:
Photographs of Earth from spacecraft and satellites.
The way ships disappear hull-first over the horizon.
Lunar eclipses, where Earth casts a consistently round shadow on the Moon.
Global navigation systems (GPS), aviation, and satellite communications, which rely on Earth's measured curved shape.
A simple way to think of it is:
Flat disk? No.
Perfect sphere? Not quite.
Slightly squashed sphere (oblate spheroid)? Yes.
If you're interested, I can also explain the strongest experiments people use to test Earth's shape for themselves without relying on space photos.
Sources
Explain the horizon experiment
Show how lunar eclipses prove it
Message Copilot
AI-generated content may be incorrect

(#322) Google Gemini/Bard

Or with Google's Gemini Pro AI on September 23, 2026:

https://gemini.google.com


The Shape of the Earth - Googl
gemini.google.com/app/250a0f91f4cfb29a
VPN
Gemini Pro
Is the Earth shaped like a sphere or is it flat like a disk?
The Earth is neither perfectly spherical nor flat like a disk; it is an oblate spheroid.
This means the planet is mostly round but slightly flattened at the North and South Poles and bulging at the equator.
Two competing forces dictate this shape:
Gravity: Pulls all of Earth's mass uniformly inward toward its center, which naturally attempts to form a perfect sphere.
Rotation (Centrifugal Force): As the Earth spins on its axis, it pushes mass outward. This outward force is strongest at the equator (where the rotational speed is highest) and zero at the poles, causing the planet's midsection to bulge.
Because of this bulge, Earth's equatorial diameter is about 43 kilometers (27 miles) wider than its pole-to-pole diameter. While the Earth looks like a perfect sphere to the human eye from space, this slight flattening is a fundamental characteristic of its geophysics.
Want to know how this shape affects gravity on the surface?
Oui
Demander à Gemini
Gemini est une IA et peut se tromper, y compris sur des personnes. Votre confidentialité et Gemini

So, yet another point against Flat Earth…

Apple Artificial Intelligence

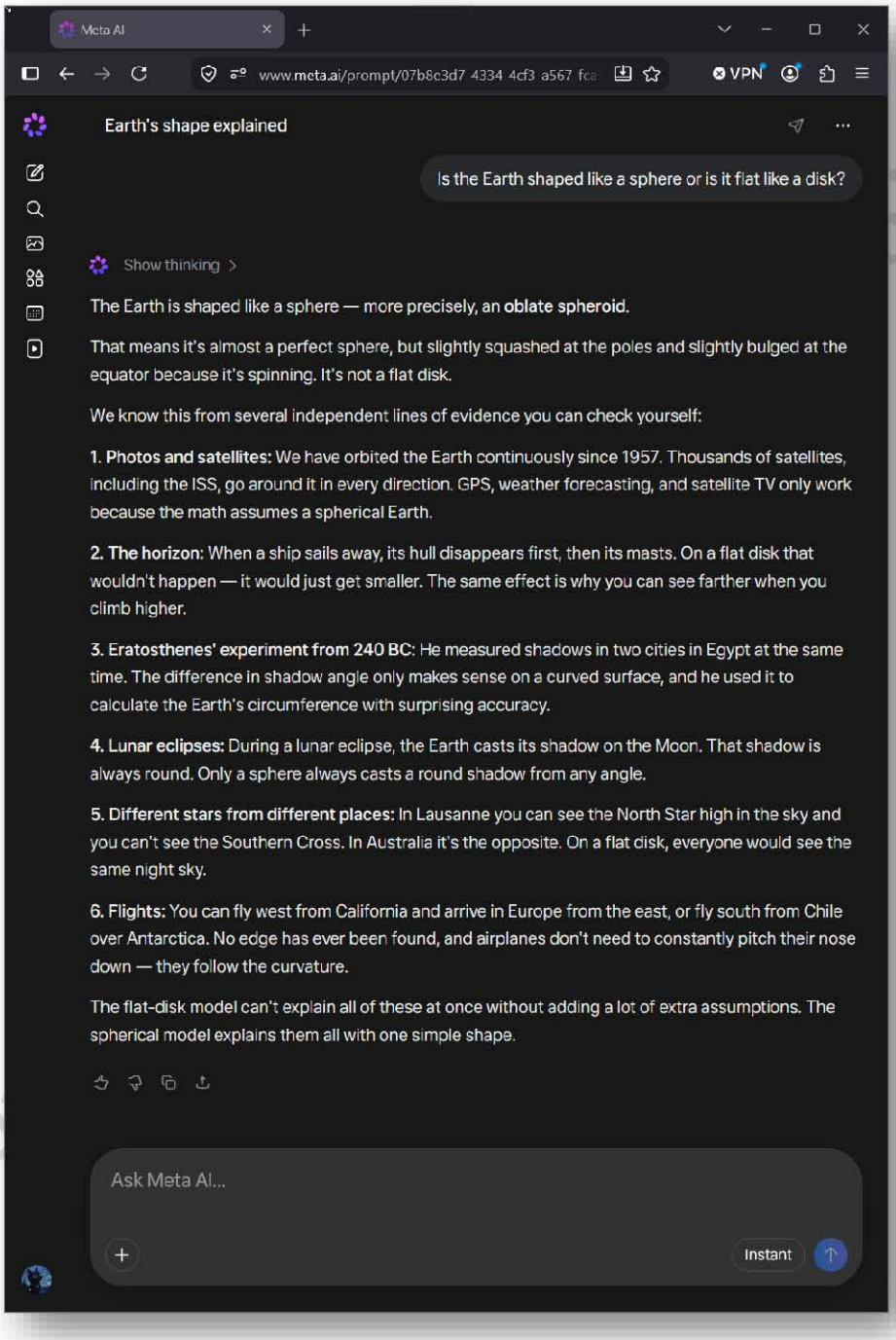
The Apple AI that was launched in March 2025 is based entirely on ChatGPT. We therefore will not consider it as an independent "proof."

translation into english ongoing

(#323) Meta AI

Or with Meta/Facebook's AI:

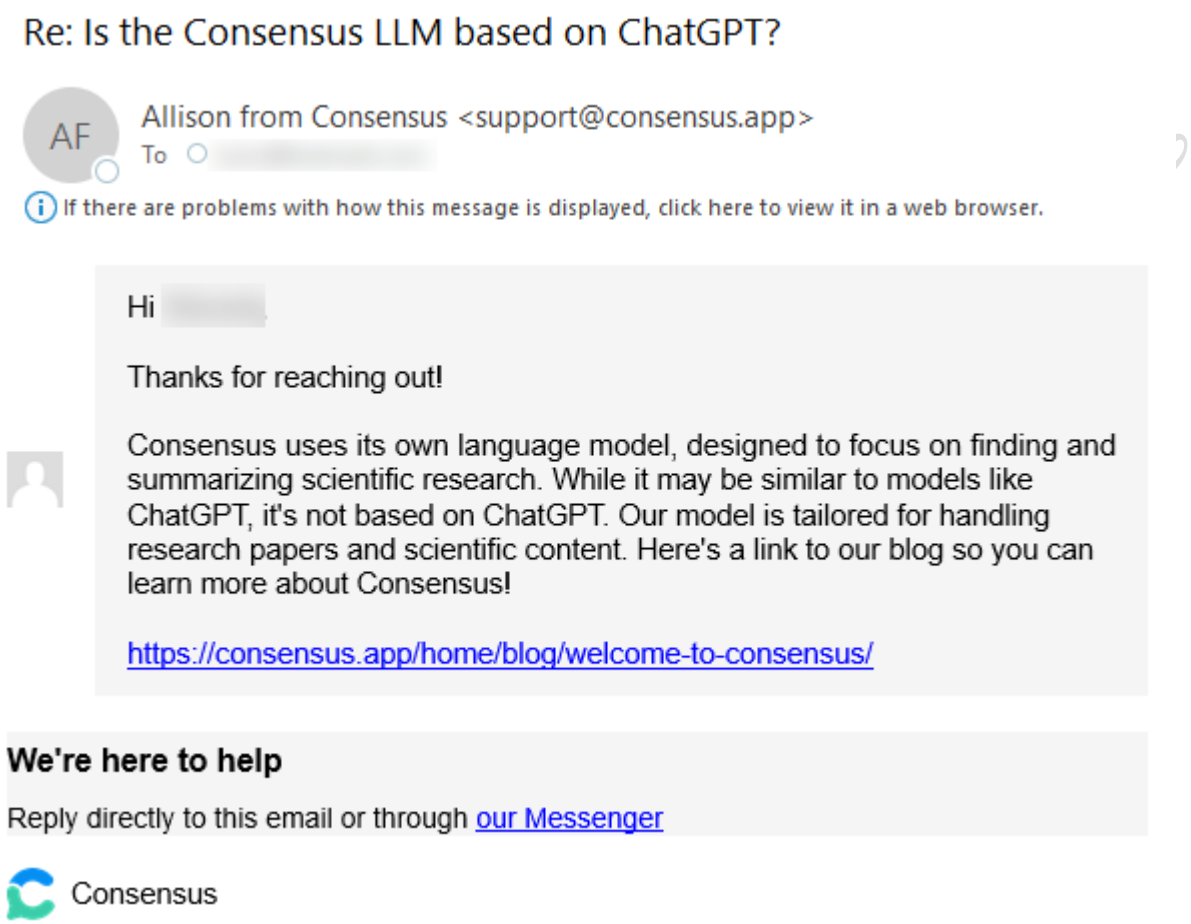
https://www.meta.ai/


Meta AI
www.meta.ai/prompt/07b8c3d7 4334 4cf3 a567 fca
VPN
Earth's shape explained
Is the Earth shaped like a sphere or is it flat like a disk?
Show thinking
The Earth is shaped like a sphere — more precisely, an oblate spheroid.
That means it's almost a perfect sphere, but slightly squashed at the poles and slightly bulged at the equator because it's spinning. It's not a flat disk.
We know this from several independent lines of evidence you can check yourself:
1. Photos and satellites: We have orbited the Earth continuously since 1957. Thousands of satellites, including the ISS, go around it in every direction. GPS, weather forecasting, and satellite TV only work because the math assumes a spherical Earth.
2. The horizon: When a ship sails away, its hull disappears first, then its masts. On a flat disk that wouldn't happen — it would just get smaller. The same effect is why you can see farther when you climb higher.
3. Eratosthenes' experiment from 240 BC: He measured shadows in two cities in Egypt at the same time. The difference in shadow angle only makes sense on a curved surface, and he used it to calculate the Earth's circumference with surprising accuracy.
4. Lunar eclipses: During a lunar eclipse, the Earth casts its shadow on the Moon. That shadow is always round. Only a sphere always casts a round shadow from any angle.
5. Different stars from different places: In Lausanne you can see the North Star high in the sky and you can't see the Southern Cross. In Australia it's the opposite. On a flat disk, everyone would see the same night sky.
6. Flights: You can fly west from California and arrive in Europe from the east, or fly south from Chile over Antarctica. No edge has ever been found, and airplanes don't need to constantly pitch their nose down — they follow the curvature.
The flat-disk model can't explain all of these at once without adding a lot of extra assumptions. The spherical model explains them all with one simple shape.
Ask Meta AI...
Instant

So, yet another point against Flat Earth…

(#324) Consensus.App

Consensus.app is an LLM that extracts scientific consensus solely from academic literature; according to its creators, it is not based on ChatGPT (and obviously not on Google AI). Let's take a look at the answer we received from Consensus.app support:



Re: Is the Consensus LLM based on ChatGPT?

AF Allison from Consensus <support@consensus.app>
To

If there are problems with how this message is displayed, click here to view it in a web browser.

Hi

Thanks for reaching out!

Consensus uses its own language model, designed to focus on finding and summarizing scientific research. While it may be similar to models like ChatGPT, it's not based on ChatGPT. Our model is tailored for handling research papers and scientific content. Here's a link to our blog so you can learn more about Consensus!

https://consensus.app/home/blog/welcome-to-consensus/

We're here to help

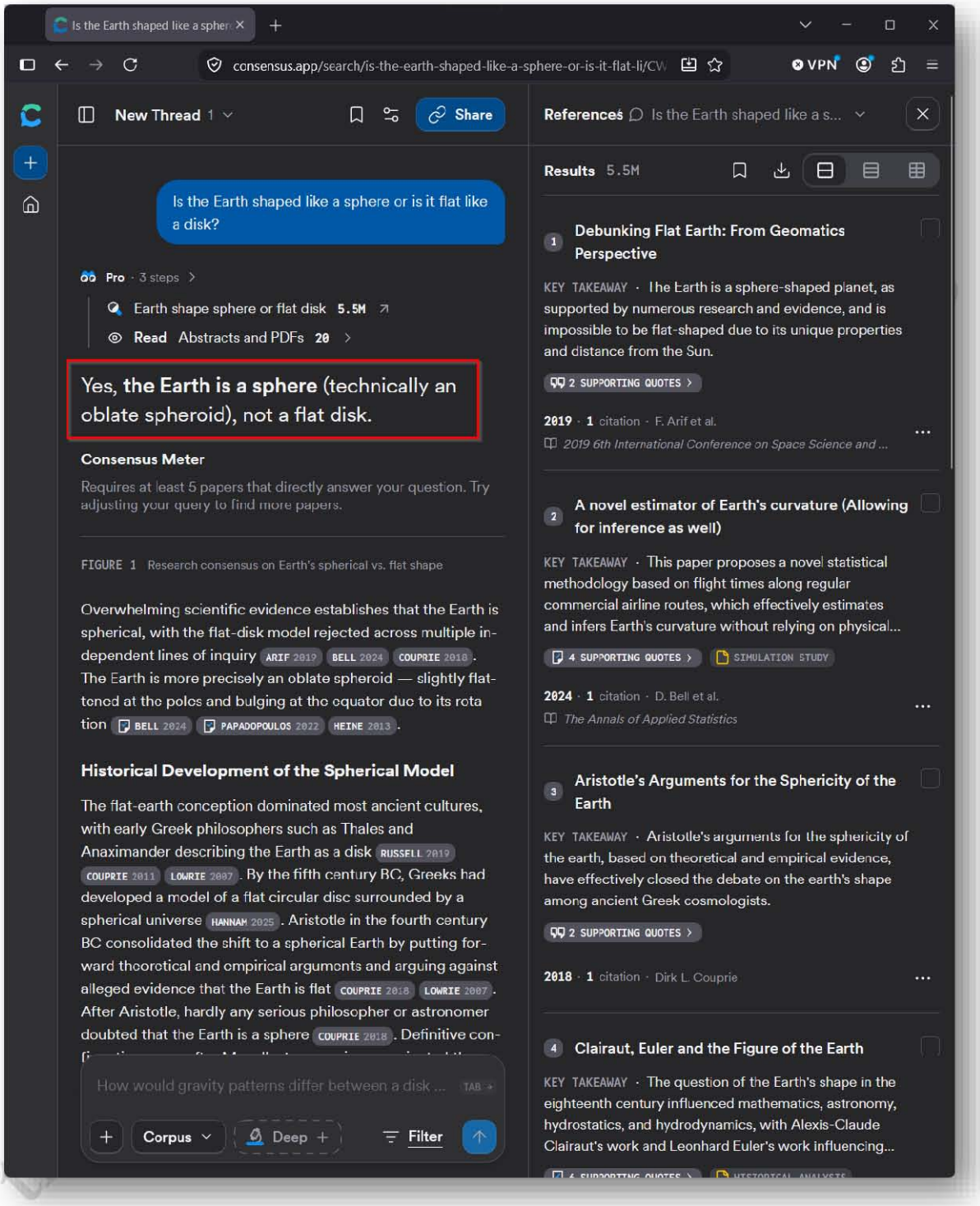
Reply directly to this email or through our Messenger

Consensus

And let's see what this AI says regarding to the same question:

https://consensus.app

translatio

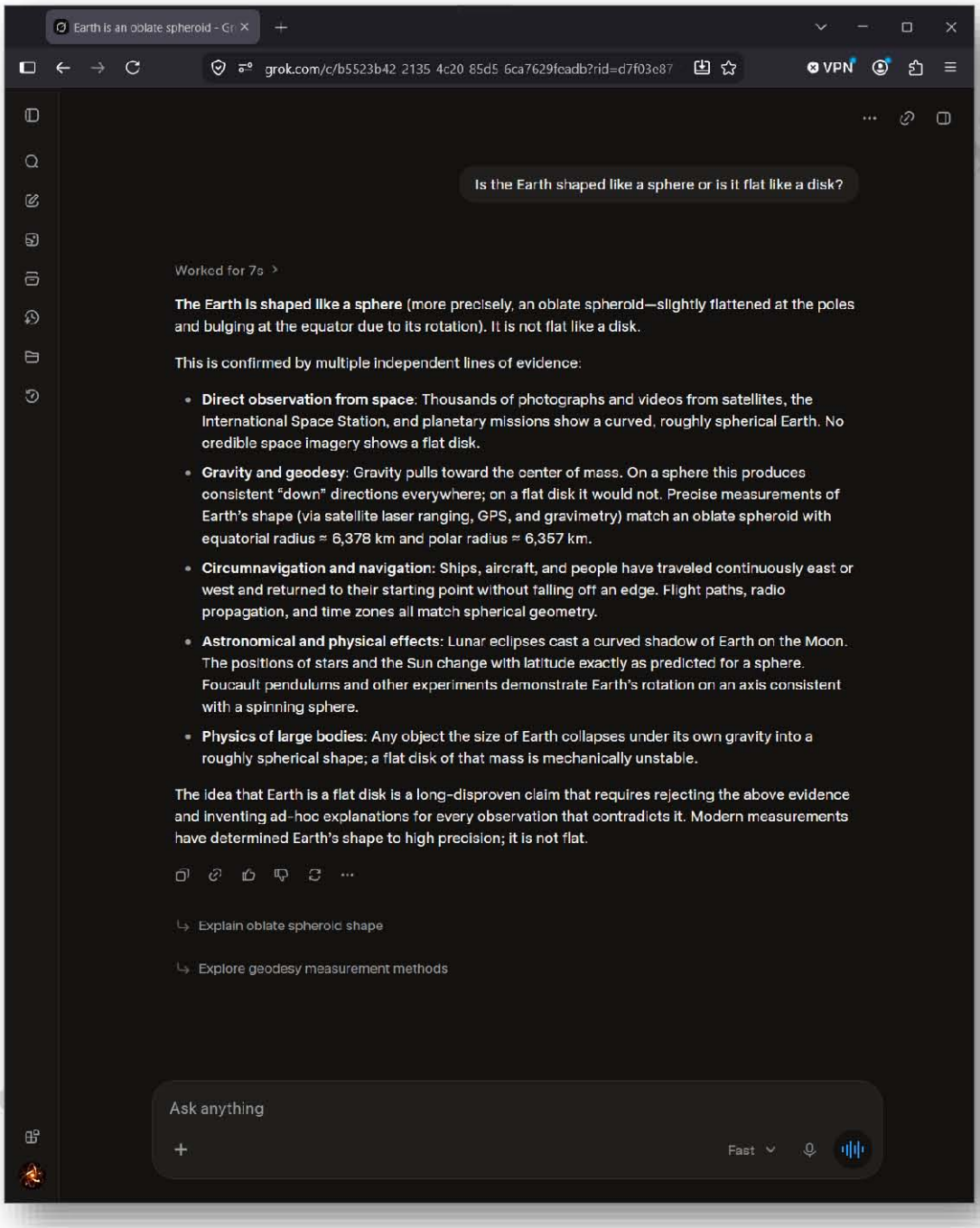

Is the Earth shaped like a spher
consensus.app/search/is-the-earth-shaped-like-a-sphere-or-is-it-flat-li/CW
VPN
New Thread 1
Share
References
Is the Earth shaped like a s...
Results 5.5M
Is the Earth shaped like a sphere or is it flat like a disk?
Pro · 3 steps
Earth shape sphere or flat disk 5.5M
Read Abstracts and PDFs 20
Yes, the Earth is a sphere (technically an oblate spheroid), not a flat disk.
Consensus Meter
Requires at least 5 papers that directly answer your question. Try adjusting your query to find more papers.
FIGURE 1 Research consensus on Earth's spherical vs. flat shape
Overwhelming scientific evidence establishes that the Earth is spherical, with the flat-disk model rejected across multiple independent lines of inquiry ARIF 2019 BELL 2024 COUPRIE 2018. The Earth is more precisely an oblate spheroid — slightly flattened at the poles and bulging at the equator due to its rotation BELL 2024 PAPADOPOULOS 2022 HEINE 2013.
Historical Development of the Spherical Model
The flat-earth conception dominated most ancient cultures, with early Greek philosophers such as Thales and Anaximander describing the Earth as a disk RUSSELL 2019 COUPRIE 2011 LOWRIE 2007. By the fifth century BC, Greeks had developed a model of a flat circular disc surrounded by a spherical universe HANNAH 2025. Aristotle in the fourth century BC consolidated the shift to a spherical Earth by putting forward theoretical and empirical arguments and arguing against alleged evidence that the Earth is flat COUPRIE 2018 LOWRIE 2007. After Aristotle, hardly any serious philosopher or astronomer doubted that the Earth is a sphere COUPRIE 2018. Definitive con-
How would gravity patterns differ between a disk ... TAB
Corpus
Deep
Filter
1 Debunking Flat Earth: From Geomatics Perspective
KEY TAKEAWAY · The Earth is a sphere-shaped planet, as supported by numerous research and evidence, and is impossible to be flat-shaped due to its unique properties and distance from the Sun.
2 SUPPORTING QUOTES
2019 · 1 citation · F. Arif et al.
2019 6th International Conference on Space Science and ...
2 A novel estimator of Earth's curvature (Allowing for inference as well)
KEY TAKEAWAY · This paper proposes a novel statistical methodology based on flight times along regular commercial airline routes, which effectively estimates and infers Earth's curvature without relying on physical...
4 SUPPORTING QUOTES
SIMULATION STUDY
2024 · 1 citation · D. Bell et al.
The Annals of Applied Statistics
3 Aristotle's Arguments for the Sphericity of the Earth
KEY TAKEAWAY · Aristotle's arguments for the sphericity of the earth, based on theoretical and empirical evidence, have effectively closed the debate on the earth's shape among ancient Greek cosmologists.
2 SUPPORTING QUOTES
2018 · 1 citation · Dirk L. Couprie
4 Clairaut, Euler and the Figure of the Earth
KEY TAKEAWAY · The question of the Earth's shape in the eighteenth century influenced mathematics, astronomy, hydrostatics, and hydrodynamics, with Alexis-Claude Clairaut's work and Leonhard Euler's work influencing...

So, yet another point against Flat Earth…

(#325) Grok 2

Or with X's (Elon Musk's) AI on September 27, 2026:

https://grok.com

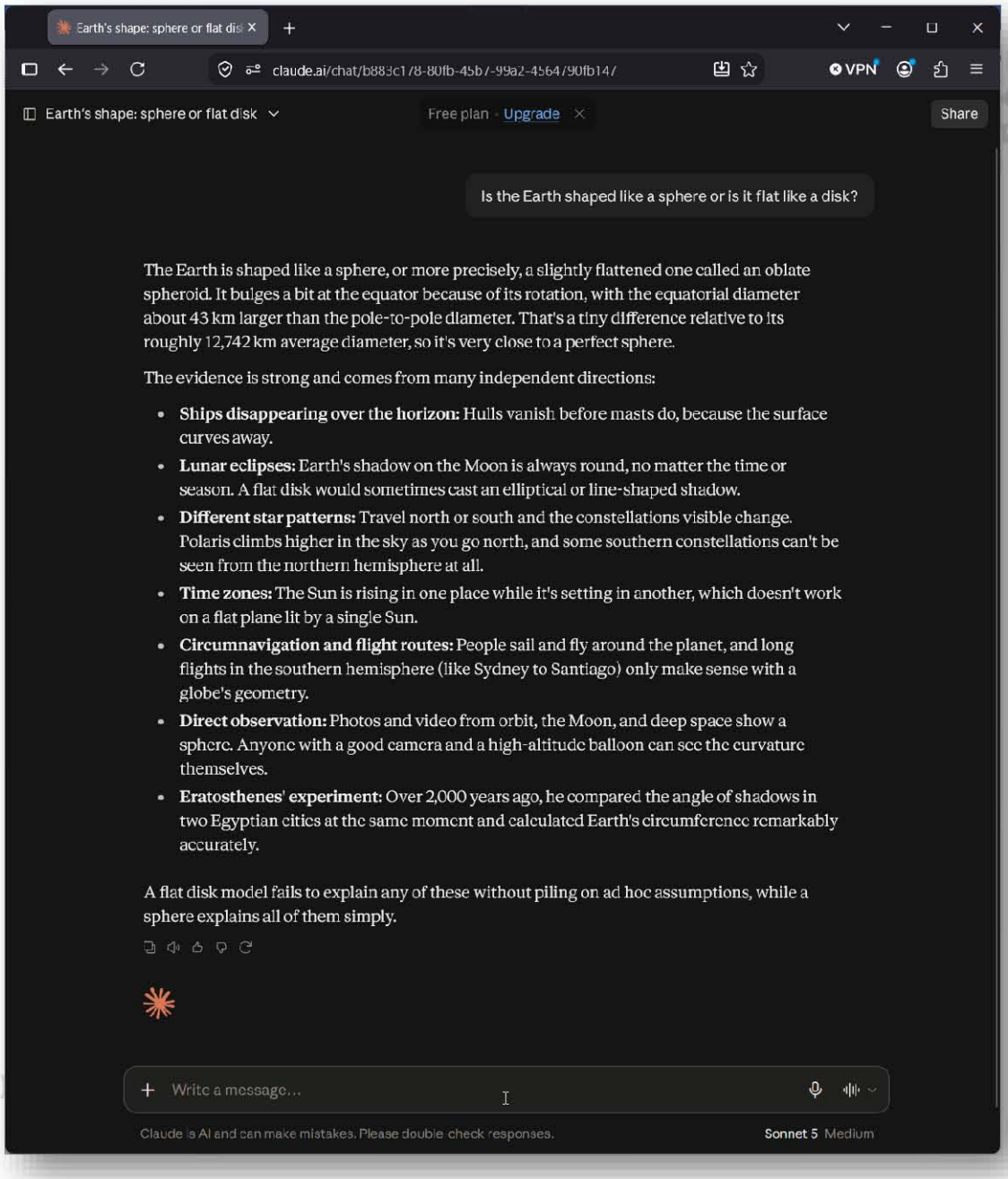

Earth is an oblate spheroid - Gr
grok.com/c/b5523b42-2135-4c20-85d5-6ca7629feadb?rid=d7f03c87
VPN
Is the Earth shaped like a sphere or is it flat like a disk?
Worked for 7s
The Earth is shaped like a sphere (more precisely, an oblate spheroid—slightly flattened at the poles and bulging at the equator due to its rotation). It is not flat like a disk.
This is confirmed by multiple independent lines of evidence:
Direct observation from space: Thousands of photographs and videos from satellites, the International Space Station, and planetary missions show a curved, roughly spherical Earth. No credible space imagery shows a flat disk.
Gravity and geodesy: Gravity pulls toward the center of mass. On a sphere this produces consistent "down" directions everywhere; on a flat disk it would not. Precise measurements of Earth's shape (via satellite laser ranging, GPS, and gravimetry) match an oblate spheroid with equatorial radius ≈ 6,378 km and polar radius ≈ 6,357 km.
Circumnavigation and navigation: Ships, aircraft, and people have traveled continuously east or west and returned to their starting point without falling off an edge. Flight paths, radio propagation, and time zones all match spherical geometry.
Astronomical and physical effects: Lunar eclipses cast a curved shadow of Earth on the Moon. The positions of stars and the Sun change with latitude exactly as predicted for a sphere. Foucault pendulums and other experiments demonstrate Earth's rotation on an axis consistent with a spinning sphere.
Physics of large bodies: Any object the size of Earth collapses under its own gravity into a roughly spherical shape; a flat disk of that mass is mechanically unstable.
The idea that Earth is a flat disk is a long-disproven claim that requires rejecting the above evidence and inventing ad-hoc explanations for every observation that contradicts it. Modern measurements have determined Earth's shape to high precision; it is not flat.
Explain oblate spheroid shape
Explore geodesy measurement methods
Ask anything
Fast

So, yet another point against Flat Earth…

(#326) Claude

Or with the AI Claude from the company Antrophic IA:

https://claude.ai

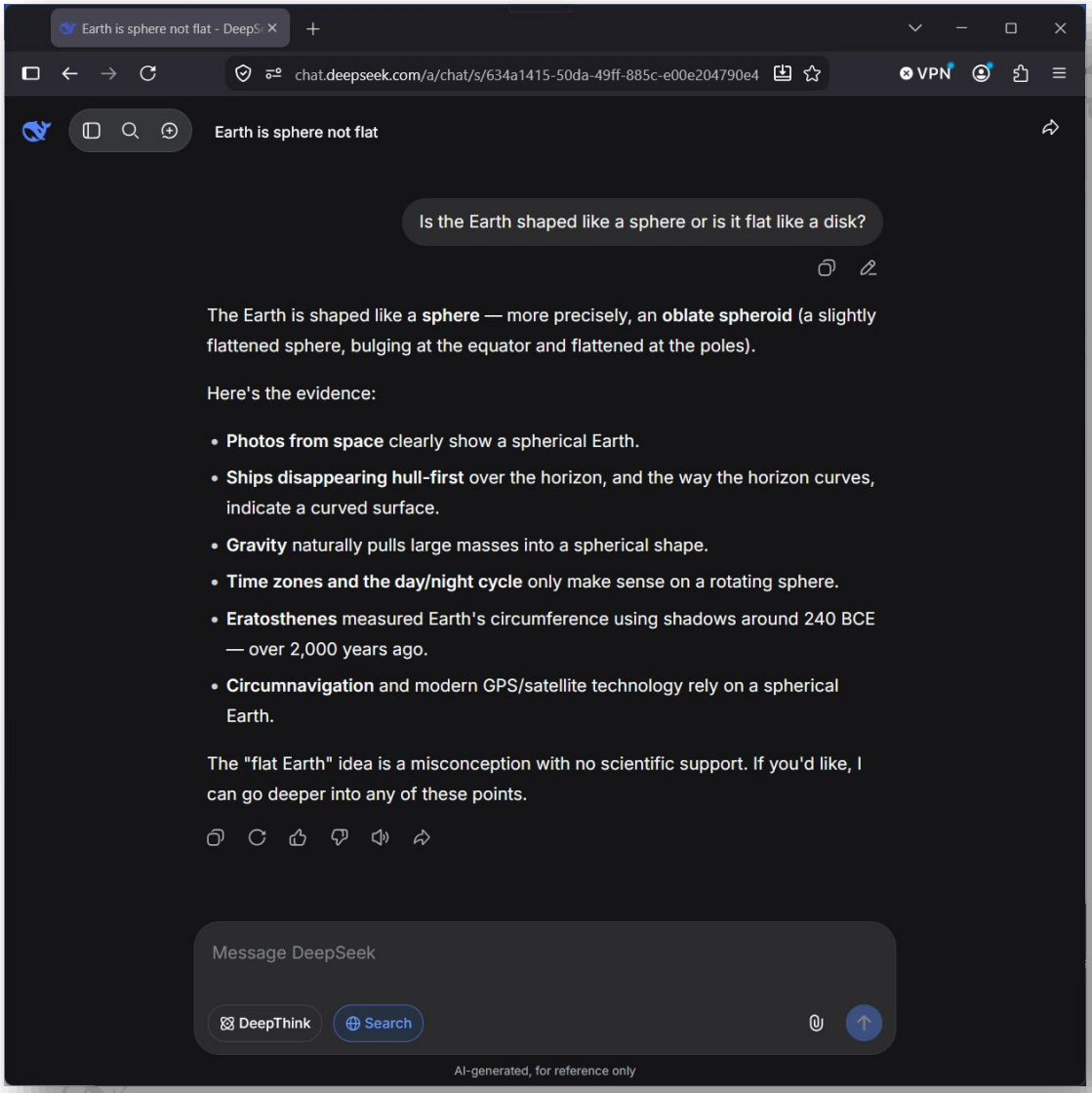

Earth's shape: sphere or flat disk
claude.ai/chat/b883c178-80fb-45b7-99a2-4564790fb147
VPN
Earth's shape: sphere or flat disk
Free plan · Upgrade
Share
Is the Earth shaped like a sphere or is it flat like a disk?
The Earth is shaped like a sphere, or more precisely, a slightly flattened one called an oblate spheroid. It bulges a bit at the equator because of its rotation, with the equatorial diameter about 43 km larger than the pole-to-pole diameter. That's a tiny difference relative to its roughly 12,742 km average diameter, so it's very close to a perfect sphere.
The evidence is strong and comes from many independent directions:
Ships disappearing over the horizon: Hulls vanish before masts do, because the surface curves away.
Lunar eclipses: Earth's shadow on the Moon is always round, no matter the time or season. A flat disk would sometimes cast an elliptical or line-shaped shadow.
Different star patterns: Travel north or south and the constellations visible change. Polaris climbs higher in the sky as you go north, and some southern constellations can't be seen from the northern hemisphere at all.
Time zones: The Sun is rising in one place while it's setting in another, which doesn't work on a flat plane lit by a single Sun.
Circumnavigation and flight routes: People sail and fly around the planet, and long flights in the southern hemisphere (like Sydney to Santiago) only make sense with a globe's geometry.
Direct observation: Photos and video from orbit, the Moon, and deep space show a sphere. Anyone with a good camera and a high-altitude balloon can see the curvature themselves.
Eratosthenes' experiment: Over 2,000 years ago, he compared the angle of shadows in two Egyptian cities at the same moment and calculated Earth's circumference remarkably accurately.
A flat disk model fails to explain any of these without piling on ad hoc assumptions, while a sphere explains all of them simply.
Write a message...
Claude is AI and can make mistakes. Please double check responses.
Sonnet 5 Medium

So, yet another point against Flat Earth…

(#327) DeepSeek

Just to look beyond American AIs, let's now consider a case involving DeepSeek - on of the most famous AI from China!

The latter gives us on September 29, 2026:


Earth is sphere not flat - DeepS
chat.deepseek.com/a/chat/s/634a1415-50da-49ff-885c-e00e204790e4
VPN
Earth is sphere not flat
Is the Earth shaped like a sphere or is it flat like a disk?
The Earth is shaped like a sphere — more precisely, an oblate spheroid (a slightly flattened sphere, bulging at the equator and flattened at the poles).
Here's the evidence:
Photos from space clearly show a spherical Earth.
Ships disappearing hull-first over the horizon, and the way the horizon curves, indicate a curved surface.
Gravity naturally pulls large masses into a spherical shape.
Time zones and the day/night cycle only make sense on a rotating sphere.
Eratosthenes measured Earth's circumference using shadows around 240 BCE — over 2,000 years ago.
Circumnavigation and modern GPS/satellite technology rely on a spherical Earth.
The "flat Earth" idea is a misconception with no scientific support. If you'd like, I can go deeper into any of these points.
Message DeepSeek
DeepThink
Search
AI-generated, for reference only

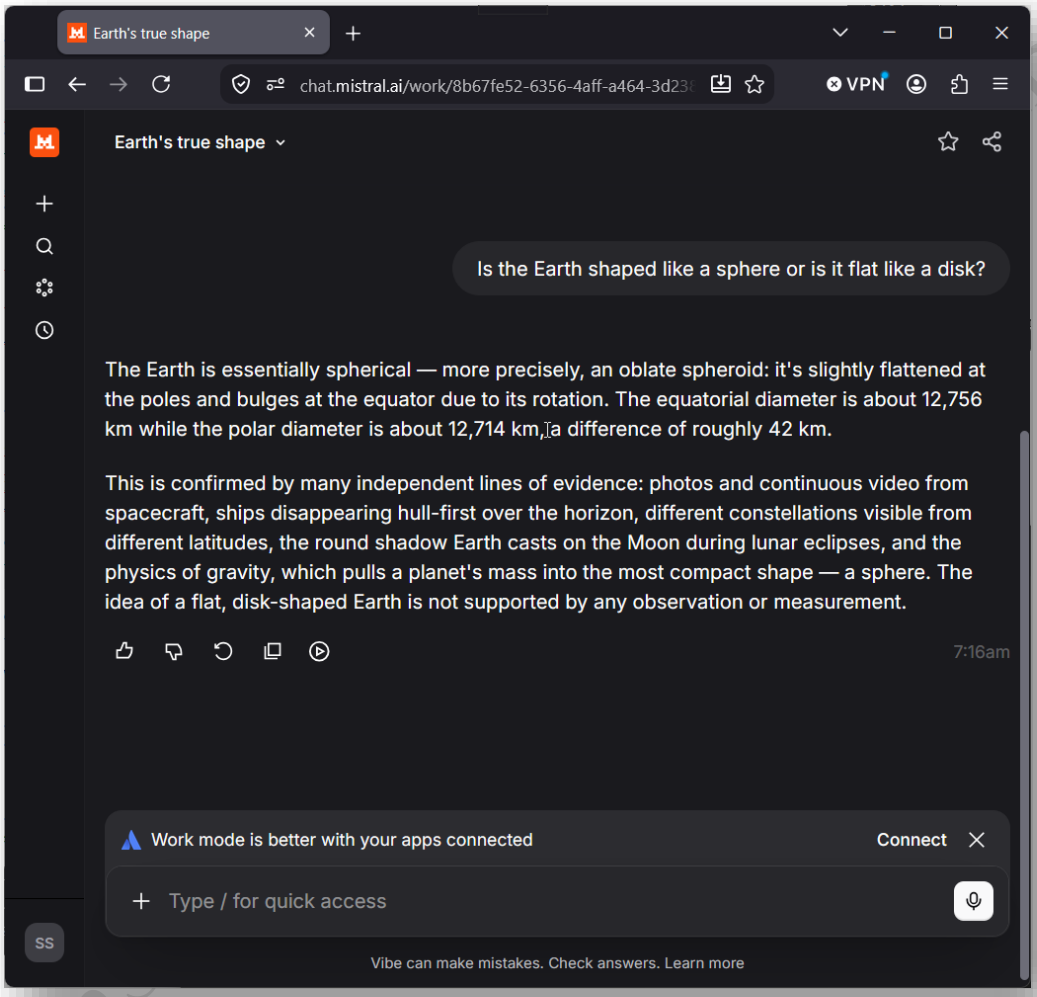
So, yet another point against Flat Earth…

(#328) Mistral

For a change from American and Chinese AIs, let's now look at a case involving the most famous AI from France: Mistral!

The latter gives us September 30, 2026:

https://chat.mistral.ai/chat


Earth's true shape
chat.mistral.ai/work/8b67fe52-6356-4aff-a464-3d23
VPN
Earth's true shape
Is the Earth shaped like a sphere or is it flat like a disk?
The Earth is essentially spherical — more precisely, an oblate spheroid: it's slightly flattened at the poles and bulges at the equator due to its rotation. The equatorial diameter is about 12,756 km while the polar diameter is about 12,714 km, a difference of roughly 42 km.
This is confirmed by many independent lines of evidence: photos and continuous video from spacecraft, ships disappearing hull-first over the horizon, different constellations visible from different latitudes, the round shadow Earth casts on the Moon during lunar eclipses, and the physics of gravity, which pulls a planet's mass into the most compact shape — a sphere. The idea of a flat, disk-shaped Earth is not supported by any observation or measurement.
7:16am
Work mode is better with your apps connected
Connect
Type / for quick access
SS
Vibe can make mistakes. Check answers. Learn more

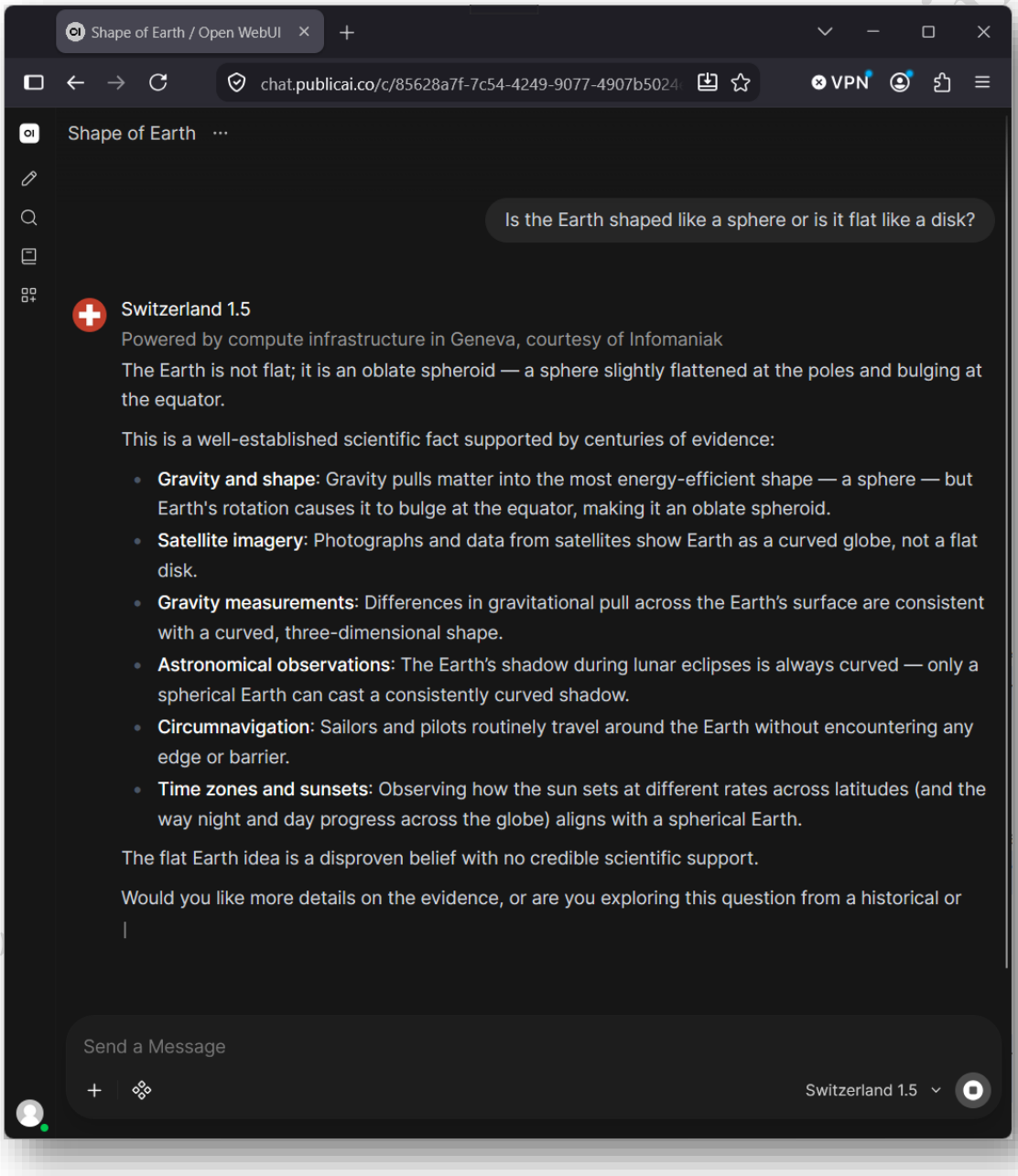
So, yet another point against Flat Earth…

(#329) Apertus

Just to look at something other than American or Chinese AIs, let's consider the case of Apertus—the most famous AI from Switzerland (a country that is, for reminder, Christian fundamentalist: it mentions the Christian God in its constitution, features a cross on its flag, and bans blasphemy).

The latter gives in Octobre 1, 2026:

https://chat.publicai.co/


Shape of Earth / Open WebUI
chat.publicai.co/c/85628a7f-7c54-4249-9077-4907b5024
VPN
Shape of Earth
Is the Earth shaped like a sphere or is it flat like a disk?
Switzerland 1.5
Powered by compute infrastructure in Geneva, courtesy of Infomaniak
The Earth is not flat; it is an oblate spheroid — a sphere slightly flattened at the poles and bulging at the equator.
This is a well-established scientific fact supported by centuries of evidence:
Gravity and shape: Gravity pulls matter into the most energy-efficient shape — a sphere — but Earth's rotation causes it to bulge at the equator, making it an oblate spheroid.
Satellite imagery: Photographs and data from satellites show Earth as a curved globe, not a flat disk.
Gravity measurements: Differences in gravitational pull across the Earth's surface are consistent with a curved, three-dimensional shape.
Astronomical observations: The Earth's shadow during lunar eclipses is always curved — only a spherical Earth can cast a consistently curved shadow.
Circumnavigation: Sailors and pilots routinely travel around the Earth without encountering any edge or barrier.
Time zones and sunsets: Observing how the sun sets at different rates across latitudes (and the way night and day progress across the globe) aligns with a spherical Earth.
The flat Earth idea is a disproven belief with no credible scientific support.
Would you like more details on the evidence, or are you exploring this question from a historical or
Send a Message
Switzerland 1.5

So ALL the AIs above reach the same conclusion, which proves once again that flattards are pathological liars.

Citations de scientifiques et ingénieurs qui confirment le Globe

De nombreuses personnes partisanes de la Terre plate considèrent (malheureusement) des citations/témoignages d'ingénieurs ou de scientifiques comme des preuves de par leur méconnaissance du fonctionnement de la Science (ils ne savant pas que le témoignage et l'opinion est le plus bas niveau de preuve en Science). C'est un problème que nous retrouvons aussi chez l'auteur d'un ouvrage de piètre qualité qui cite (sans sources !) des ingénieurs en affirmant que ces derniers confirment que la Terre est plate.

Pour répondre à cet argument fallacieux, nous allons aussi présenter ci-dessous des citations, vidéos d'ingénieurs, de scientifiques, de navigateur et pilotes plus ou moins connus dont voici un résumé sous forme de table ci-dessous :

Type	Nombre
Scientifiques	29
Ingénieurs	4
Pilotes professionnels	11
Marins/Skippeurs professionnels	10
Autres (sportifs de l'extrême, astronautes)	3
Total	**57**

Citations de scientifiques

Voici une petite liste (non-exhaustive) d'environ 30 citations sourcées (ouvrage, article, date, numéro de page) de scientifiques plus ou moins connus de différentes époques qui confirment que la Terre est une sphère / sphère oblate / géoïde.

Nous les avons mis dans l'ordre du plus ancien au plus récent.

translation into english ongoing

(#330) Aristote (philosophe et polymathe)

Aristote (philosophe et polymathe de la Grèce antique) dans son livre *Du ciel* au *Livre II*, partie *14* (3e siècle avant notre ère[11]) : « **Sa forme doit nécessairement être sphérique**. Car chaque partie de la Terre a un poids jusqu'à ce qu'elle atteigne le centre, et la secousse des parties plus grandes et plus petites ne produirait pas une surface ondulée, mais plutôt une compression et une convergence de partie en partie jusqu'à ce que le centre soit atteint ».

(#331) Claude Ptolémée (astronome, astrologue, mathématicien et géographe)

Claude Ptolémée (astronome, astrologue, mathématicien et géographe) dans son Almageste, chapitre H15 (150) écrit pendant le 2e siècle de notre ère : « Que la Terre, prise dans son ensemble, soit sensiblement sphérique peut être mieux compris à partir des considérations suivantes ».

(#332) Archimède (mathématicien, physicien, ingénieur, astronome)

Archimède (mathématicien, physicien, ingénieur, astronome et inventeur grec ancien qui a dérivé la loi de la flottabilité) dans son livre *Sur les corps flottants* au *Livre I*, *section 2*, *partie 2* (2e siècle avant notre ère) : « La surface de tout fluide qui est situé de telle manière qu'il reste immobile **aura la forme d'une sphère qui a le même centre que la Terre** ».

[11] Le plus ancien texte connu à ce jour mentionnant une Terre sphérique date du Ve siècle avant notre ère dans un poème du philosophe grecque Parmenides nommé « Sur la Nature ».

(#333) Strabon (géographe, philosophe)

Strabon (géographe, philosophe et historien grec ancien) dans son livre *Geographica* dans la partie C, section 11, paragraphe 20 (993) : « ...le monde est également sphérique, **et la surface de la Terre est également sphérique**... ».

(#334) Galileo Galilei (mathématicien, géomètre, physicien et astronome)

Galileo Galilei (mathématicien, géomètre, physicien et astronome) dans son *Dialogue sur les deux grands systèmes du Monde* (1632) : « Considérons maintenant l'ensemble du **globe terrestre**… ».

(#335) Isaac Newton (polymathe, physicien, astronome, alchimiste, théologien et auteur)

Isaac Newton (polymathe anglais actif comme mathématicien, physicien, astronome, alchimiste, théologien et auteur) dans son livre *Traité du système du monde* (publié en 1728 à titre posthume) affirme clairement à plusieurs reprises que la Terre est un globe : « Soit ABCD le globe de la Terre... » (page 42) ; « ...soit la perpendiculaire f_G rencontrant **le globe de la Terre**... » (page 84).

(#336) Nicolas Copernic (astronome polonais ou allemand, également chanoine, médecin et mathématicien)

Nicolas Copernic (astronome polonais ou allemand, également chanoine, médecin et mathématicien) dans son De Revolutionibus Orbium Coelestium (Des révolutions des sphères célestes), 1543, chapitre 2, paragraphe 35 : « ...**La Terre est également sphérique**, car elle exerce une pression sur son centre de toutes parts... ».

(#337) Leonhard Euler (mathématicien, physicien, astronome, géographe, logicien et ingénieur)

Leonhard Euler (mathématicien, physicien, astronome, géographe, logicien et ingénieur suisse) dans son article 32 *Sur la forme de la Terre*, publié dans Anmerkungen über die Zeitungen, Saint-Pétersbourg (1738) : « Après que les croyances absurdes des Anciens concernant la forme de la Terre eurent été suffisamment réfutées, non seulement par les philosophes, mais par des voyages réels, il apparut comme une question établie **que la Terre devait être parfaitement ronde comme une boule** ».

(#338) Joseph-Louis Lagrange (mathématicien, physicien et astronome)

Joseph-Louis Lagrange (mathématicien, physicien et astronome) dans ses divers travaux mentionne à plusieurs reprises le fait que la Terre est un globe. Comme dans son *Mémoire sur le passage de Vénus* publié à l'Académie des Sciences et Belles-Lettres de Berlin, t. XXII, page 8 (1766) : « Or, si par le pôle *P* **du globe terrestre** et le lieu *L* (fig. 4.) dont la latitude est... ».

(#339) Pierre-Simon, marquis de Laplace (ingénieur, astronome, philosophe, physicien)

Pierre-Simon, marquis de Laplace (savant dont les travaux furent importants pour le développement de l'ingénierie, des mathématiques, des statistiques, de la physique, de l'astronomie et de la philosophie) dans son célèbre *Traité de mécanique céleste* en 5 volumes publié à l'imprimerie de Crapelet (1798 et 1799) mentionne des multiples fois la forme

translation into english ongoing

sphérique et globe de la Terre comme par exemple à la page 343 section 13 : « Comparons maintenant la théorie précédente avec les observations, et voyons les conséquences qui en résultent **sur la constitution du globe terrestre** ».

(#340) Siméon Denis Poisson (mathématicien et physicien)

Siméon Denis Poisson (mathématicien et physicien) dans son très célèbre *Traité du mouvement de la Terre autour de son centre de gravité* publié à l'Académie des sciences à la page 10 (1827) : « Cela ne peut avoir lieu qu'autant que l'axe de rotation s'écarte très-peu de l'un des axes principaux, qui doit être celui du plus grand moment d'inertie, à cause que **la Terre est un sphéroïde aplatit sur ses pôles** ».

(#341) Jean-Baptiste Joseph Fourier (mathématicien et physicien français)

Jean-Baptiste Joseph Fourier (mathématicien et physicien français) dans son *Sur les températures de la sphère terrestre et de l'espace interplanétaire* paru originellement dans Mémoires de l'Académie Royale des Sciences de l'Institut de France VII 570-604 (1827) : « La théorie mathématique de la chaleur fournit plusieurs autres conséquences de ce type, dont la certitude est indépendante de toutes les hypothèses sur l'état **de l'intérieur du globe terrestre** ».

(#342) Albert Einstein (PhD en physique, Professeur, Prix Nobel de Physique)

Albert Einstein (PhD Physicien, Professeur, Prix Nobel de Physique), lors de sa conférence à Chicago/États-Unis (Chicago Lectures) à la Francis Parker School le 6 mai 1921, à la page 28 de ses notes de cours, fait référence à la forme sphérique de la Terre : « Si quelqu'un court autour de la Terre, **il ne trouvera nulle part où finir, tout comme une balle**. Si nous remplissons la Terre ou la sphère de bâtons, alors nous arrivons à une fin, et s'il est vrai qu'il y a de la matière partout dans le monde, alors la Terre est illimitée mais finie, et nous devons atteindre la fin ».

(#343) Auguste Piccard (PhD en physique de l'ETHZ)

Auguste Piccard (doctorat en physique de l'ETHZ, Suisse) dans *Terre, taille et mer* (1959) publié chez Oxford University Press. Nous avons :

- Partie II, Section 6, page 120 : « Les géophysiciens ont installé un réseau de stations **sur le globe** ».
- Partie III, page 147 : « …trouveront d'énormes ressources dans les mers, qui couvrent les trois quarts **du globe**. ».
- Appendice 12, page 187 : « …C'est pourquoi, parce que dans dix ans peut-être, un explorateur courageux, encore inconnu, désirera, à l'autre bout **du globe**... ».

(#344) Richard Feynman (PhD physicien américain)

Richard Feynman (physicien américain, l'un des plus influents de la seconde moitié du 20e siècle, en raison notamment de ses travaux sur l'électrodynamique quantique, les quarks et l'hélium superfluide) dans son *Lectures de Richard Feynman sur la Physique*, Volume 7,

translation into english ongoing

chapitre 5 (1964) : « Que pouvons-nous comprendre d'autre lorsque nous comprenons la gravité ? **Tout le monde sait que la Terre est ronde**. Pourquoi la Terre est-elle ronde ? C'est facile, c'est à cause de la gravitation. On peut comprendre que la Terre est ronde simplement parce que tout attire tout le reste et qu'elle s'est attirée elle-même autant qu'elle le pouvait *!* »

(#345) Edgar Dean Mitchell (PhD, ingénieur en aéronautique et astronautique du MIT)

Edgar Dean Mitchell (PhD, ingénieur en aéronautique et astronautique du MIT), astronaute de la NASA et pilote du module lunaire d'Apollo 14 en et qui a passé 9 heures à travailler sur la surface lunaire dans la région des hautes terres de Fra Mauro, et a été la sixième personne à marcher sur la Lune : « Soudain, de derrière le bord de la lune, dans de longs mouvements lents d'une immense majesté, émerge un joyau bleu et blanc étincelant, **une sphère bleu ciel** légère et délicate lacée de voiles blancs tourbillonnant lentement s'élevant progressivement comme une petite perle dans une épaisse mer de mystère noir. Il faut plus d'un instant pour réaliser pleinement que **c'est la Terre** - notre maison ».

(#346) Hans Volland (PhD, professeur, Institut de radioastronomie, Université de Bonn, Allemagne)

Hans Volland (PhD, professeur, Institut de radioastronomie, Université de Bonn, Allemagne), *Atmosphère et rotation de la Terre* (1996) publié dans Surveys in Geophysics, 17, 101-144 : « **La Terre en rotation en tant que géoïde gyroscopique** (approximativement un sphéroïde aplati) est soumise à des couples externes et internes. Les couples externes sont les forces de marée exercées par le Soleil et la Lune sur le renflement équatorial de la Terre qui provoquent la précession de l'axe de rotation de la Terre le long d'un cône sur 25 700 ans... La couche limite atmosphérique où se produit principalement le frottement se compose de trois régions (par exemple, Stull, 1989 ; Peixoto et Oort, 1992). La première est une fine couche superficielle laminaire au-dessus du sol, généralement de quelques millimètres d'épaisseur, où les effets visqueux dominent et où les mouvements relatifs entre le fluide et la surface solide sont empêchés ».

(#347) Olena Kuzii et Andrij Rovenchak (département de physique théorique, Université nationale Ivan Franko de Lviv, Ukraine)

Olena Kuzii et Andrij Rovenchak (Département de physique théorique, Université nationale Ivan Franko de Lviv, Ukraine), *À quoi ressemblerait la gravitation d'une Terre plate et pourquoi donc la Terre n'est pas plate* publié dans European Journal of Physics (2019), Volume 2, numéro 3 : « À partir des résultats obtenus, nous sommes en mesure de tirer quelques conclusions concernant un monde à **Terre plate et de démontrer ses contradictions avec ce qui est observé dans la réalité** ».

(#348) Bowie William (diplômes honorifiques de l'Université d'Edimbourg)

Bowie William (diplômes honorifiques de l'Université d'Edimbourg, Ecosse, à la réunion de l'Union Géodésique et Géophysique Internationale) dans *Isostasie et taille et forme de la Terre* publié dans Science, volume 39, numéro 1011, page 697-701 (1914) : « *L'annonce par Newton en 1687 de sa théorie selon laquelle la Terre était un sphéroïde aplati ajouta beaucoup d'intérêt au sujet de sa forme exacte. Une aire méridionale d'environ 81/2 degrés, s'étendant au nord et au sud de Paris, fut mesurée par J. et D. Cassini entre les années 1683 et 1716. Les résultats des premiers calculs de cette aire indiquent que la longueur du degré était plus petite*

translation into english ongoing

à l'extrémité nord qu'à l'extrémité sud. ***Cela donna à la Terre la forme d'un sphéroïde allongé****. Une grande controverse s'éleva sur la question de savoir si la Terre avait la forme d'un sphéroïde aplati ou allongé, et pour trancher cette question, l'Académie française envoya des expéditions au Pérou en 1735 et en Laponie l'année suivante pour mesurer les ares près de l'équateur et dans le cercle arctique. Le résultat de ces mesures confirma la théorie du sphéroïde aplat* ».

(#349) Gates, W. Lawrence (PhD en météorologie du MIT)

Gates W. Lawrence (PhD en météorologie du Massachusetts Institute of Technology) dans *Derivation of the Equations of Atmospheric Motion in Oblate Spheroidal Coordinates* publié dans le Journal of the atmosphere sciences, volume 61, numéro 20, pages 2478-2487 (2004) : « **La Terre est plus proche d'un sphéroïde aplati** que d'une sphère, ce qui rend théoriquement intéressant le développement d'équations atmosphériques du mouvement en coordonnées sphéroïdales ».

(#350) He Xianqiang et Cie (PhD en électronique physique)

He Xianqiang (PhD en électronique physique de l'Institut de physique technique de Shanghai), Knut Stamnes (PhD en physique et professeur de physique au Stevens Institute of Technology), Yan Bai (Second Institute of Oceanography,) dans *Effets de la courbure de la Terre sur la correction atmosphérique pour la télédétection de la couleur de l'océan* publié dans Remote Sensing of Environment (Elsevier) Volume 209, pages 118-133 (2018) : « **La courbure de la Terre a un impact significatif** sur la télédétection de la couleur de l'océan, et sa prise en compte dans la correction atmosphérique est cruciale pour une grande précision ».

(#351) Niklas Axel Mörner af Morlanda (doctorant en géologie quaternaire, l'université de Stockholm)

Niklas Axel Mörner af Morlanda (doctorant en géologie quaternaire, géologue et géophysicien suédois, responsable de l'unité de paléogéophysique et de géodynamique à l'université de Stockholm) dans *Geoidal topography: Origin and time* consistent publié chez Springer Geodetic Features of the Ocean Surface and their Implications, pages 205-208 (1984) : « ***La topographie du géoïde, en tant que mesure directe de la distribution irrégulière de la densité au sein de la Terre****, fournit la preuve des changements de densité au sein de la Terre au fil du temps, indiquant une Terre hautement dynamique* ».

(#352) William Edward Featherstone (PhD, professeur de géodésie)

William Edward Featherstone (PhD, professeur de géodésie, Curtin University, Perth, Australie) dans *On the use of the geoid in geophysics: a case study over the North West Shelf of Australia* publié dans Exploration Geophysics, volume 28, numéro 2, pages 52-27 (1997) : « **Le géoïde est la surface fondamentale qui définit la figure de la Terre**. Il est approximé par le niveau moyen de la mer et ondule en raison des variations spatiales du champ de gravité de la Terre ».

(#353) John Beckman (PhD en physique théorique et astrophysique à l'université d'Oxford)

John Beckman (PhD en Physique Théorique et astrophysique à l'université d'Oxford) vol à bord du Concorde 001 lors de l'éclipse solaire du 10 juillet 1993 (calendrier holocène) : « Tout

translation into english ongoing

le monde était très concentré sur son travail, mais j'ai quand même eu le temps de regarder par une fenêtre latérale pour voir l'ombre, la pénombre et la lumière qui perçait à peine derrière. De notre altitude**, je pouvais même voir la courbure de la Terre**, c'était incroyable. J'ai pu aussi observer la couronne solaire, et alors que la lune occultait progressivement le disque solaire, j'ai vu la chromosphère, qui émettait des éclats de lumière rouge ».

(#354) Michio Kaku (PhD en physique)

Michio Kaku (PhD, physicien américain, communicateur scientifique, futurologue et auteur de vulgarisation scientifique, professeur de physique théorique au City College de New York et au CUNY Graduate Center) dans son *Merveille de l'Univers* (2011) : « **Mais pourquoi la Terre est-elle une sphère ? En fait, pourquoi toutes les planètes et toutes les étoiles sont-elles sphériques ?** »

(#355) Brian Cox (PhD en physique)

Brian Cox (PhD, physicien britannique, membre de la Royal Society et professeur à l'université de Manchester1. Il est membre du groupe Physique des particules de l'université de Manchester et travaille sur le détecteur ATLAS au Grand collisionneur de hadrons (LHC)) dans son *Merveille de l'Univers* (2011) : « **Mais pourquoi la Terre est-elle une sphère ? En fait, pourquoi toutes les planètes et toutes les étoiles sont-elles sphériques ?** »

translation into english ongoing

Citations d'ingénieurs, pilotes, médecins et sportifs de l'extrême

Voici une petite liste (non-exhaustive) de 10 citations sourcées d'ingénieurs, pilotes, médecins et sportifs de l'extrême (et sourcées !) qui confirment que la Terre est une sphère oblate/géoïde de différentes époques.

Nous les avons mis dans l'ordre du plus ancien au plus récent.

(#356) Alexeï Lenov (pilote de l'armée de l'air de Chuguev, astronaute)

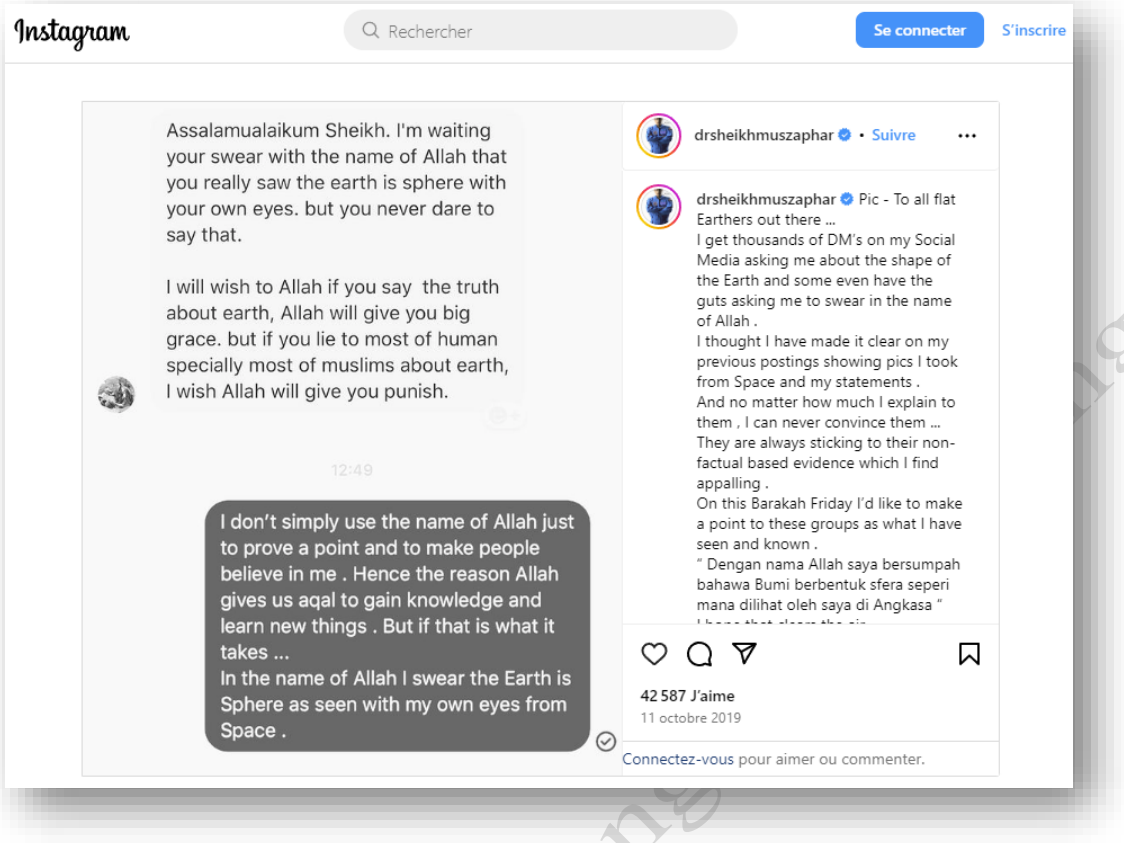
Alexeï Leonov (diplômé de l'École supérieure des pilotes de l'armée de l'air de Chuguev) était un cosmonaute soviétique et russe, général de division de l'armée de l'air qui, le 18 mars 1965 (calendrier holocène), fut le premier homme à effectuer une sortie dans l'espace, sortant de la capsule lors de la mission Voskhod 2 pendant 12 minutes et 9 secondes : « *La Terre était petite, bleu clair, et si touchante de solitude, notre maison qu'il fallait défendre comme une relique sacrée. La* ***Terre était absolument ronde****. Je crois que je n'ai jamais su ce que signifiait la rondeur du monde jusqu'à ce que je voie la Terre depuis l'espace* ».

https://www.theguardian.com/world/2015/mar/18/russia-soviet-first-space-walk-alexei-leonov

(#357) Cheikh Muszaphar Shukor Al Masrie bin Sheikh Mustapha (médecin et astronaute)

Le cheikh Muszaphar Shukor Al Masrie bin Sheikh Mustapha (Dr en chirurgie orthopédique Malaisien) a participé au vol spatial vers la Station Spatiale Internationale à bord du Soyouz TMA-11 avec l'équipage de l'*Expédition 16* le 10 octobre 2007 pour un programme de dix jours dans l'espace. Il a partagé sur son compte Instagram personnel le 11 octobre 2019 une discussion privée sur Instagram où il a écrit à un autre musulman : « *Au nom d'Allah, je jure que la Terre est une sphère telle que je la vois de mes propres yeux depuis l'espace ». Le cheikh* Muszaphar a également écrit dans la description de son message : *« Je n'utilise pas simplement le nom de Dieu juste pour prouver quelque chose et faire en sorte que les gens me croient, mais si c'est ce qu'il faut… alors je jure au nom de Dieu que* ***la Terre est une sphère*** *telle que je la vois de mes propres yeux depuis l'espace* ».

traduction intégrale en anglais en cours


Instagram
Rechercher
Se connecter
S'inscrire
Assalamualaikum Sheikh. I'm waiting your swear with the name of Allah that you really saw the earth is sphere with your own eyes. but you never dare to say that.
I will wish to Allah if you say the truth about earth, Allah will give you big grace. but if you lie to most of human specially most of muslims about earth, I wish Allah will give you punish.
12:49
I don't simply use the name of Allah just to prove a point and to make people believe in me . Hence the reason Allah gives us aqal to gain knowledge and learn new things . But if that is what it takes ...
In the name of Allah I swear the Earth is Sphere as seen with my own eyes from Space .
drsheikhmuszaphar • Suivre
drsheikhmuszaphar Pic - To all flat Earthers out there ...
I get thousands of DM's on my Social Media asking me about the shape of the Earth and some even have the guts asking me to swear in the name of Allah .
I thought I have made it clear on my previous postings showing pics I took from Space and my statements .
And no matter how much I explain to them , I can never convince them ...
They are always sticking to their non-factual based evidence which I find appalling .
On this Barakah Friday I'd like to make a point to these groups as what I have seen and known .
" Dengan nama Allah saya bersumpah bahawa Bumi berbentuk sfera seperi mana dilihat oleh saya di Angkasa "
42 587 J'aime
11 octobre 2019
Connectez-vous pour aimer ou commenter.

Il y a une Fatwa disponible ici :

https://www.islam.gov.my/images/garis-panduan/Buku-Garis-Panduan-ISS-Dalam-Versi-Malaysia-Arab-Russia-Inggeris.pdf

translation into eng

(#358) Felix Baumgartner (parachutiste autrichien, casse-cou et Base jumper)

Felix Baumgartner (parachutiste autrichien, casse-cou et Base jumper) détenteur du record du monde de saut en parachute d'une hauteur estimée à 39 km le 14 octobre 2012 : « *Quand vous êtes debout dans une combinaison pressurisée, la seule chose que vous entendez est votre respiration, et vous pouvez voir la* ***courbure de la Terre*** *; vous pouvez voir que le ciel est totalement noir* ».

(#359) Buz Carpenter (diplômé de l'Académie de l'USAF, pilote de SR-71 Blackbird)

Le colonel Buz Carpenter, diplômé de l'Académie de l'USAF (United States Air Force), pilote du Lockheed SR[12]-71 (Blackbird) dans l'US Air Force dans une interview vidéo de Lockheed Martin en 2013 : « *J'aimerais pouvoir emmener tout le monde jusqu'à 85 000 pieds parce qu'on peut voir à 350 miles dans une direction.* ***On voit la courbure de la Terre*** ».

https://www.youtube.com/watch?v=vpVT5Lr0BbI

(#360) Anderle, Richard J. (laboratoire d'analyse numérique et computationelle, USNSWC)

Anderle, Richard J. (Computation and Analysis Laboratory, US Naval Surface Weapons Center) dans *Détermination du géoïde terrestre par observations satellite* NWL Report No. 2027 (11966) : « *Les observations par satellite peuvent* ***déterminer le géoïde terrestre*** *avec*

[12] SR signifiant: Strategic Reconnaissance

une précision d'environ 20 mètres, mais des données supplémentaires et des techniques de calcul peuvent améliorer cette précision à 10 mètres ou mieux ».

(#361) Zhiping Lu et Al. (département de géodésie, Institut universitaire d'ingénierie de l'information de topographie et de cartographie, Zhengzhou, Chine)

Zhiping Lu et Al. (Département de géodésie, Institut universitaire d'ingénierie de l'information de topographie et de cartographie, Zhengzhou, Chine) dans *Le géoïde et les différents systèmes de hauteur* publié dans Introduction au datum géodésique et aux systèmes géodésiques, publié dans Springer (12014) : « *La forme de la Terre étudiée en géodésie fait principalement référence* ***à la forme du géoïde, qui est la forme physique de la Terre*** *et sert de surface de référence pour la détermination de la hauteur ».*

(#362) Nikola Tesla (inventeur)

Nikola Tesla, dans son article *The Problem of Increasing Human Energy with Special References to the Harnessing of the Sun's Energy*, publié par Century Magazine (Juin 11900), nous avons plusieurs passages qui confirment que Tesla savait que la Terre était un globe :

- Page 196 : « Ce métal, semble-t-il, a une origine entièrement différente de celle du **reste du globe**. »
- Page 199 : « C'est un fait bien connu que les parties intérieures **du globe** sont très chaudes, la température augmentant, comme le montrent les observations, à mesure que l'on se rapproche du centre à un rythme d'environ 1 degré C pour chaque centaine de pieds de profondeur. »
- Page 200 : « Les difficultés de creuser des puits et de placer des chaudières à des profondeurs de, disons, douze mille pieds, correspondant à une augmentation de température d'environ 120 degrés C., ne sont pas insurmontables, et nous pourrions certainement profiter de cette façon de la **chaleur interne du globe**. »
- Page 201 : « En réalisant un tel plan, nous devrions être en mesure d'obtenir en tout point **du globe** un approvisionnement continu en énergie, de jour comme de nuit. »
- Page 207 : « J'étais cependant convaincu qu'avec des machines bien conçues, les signaux pourraient être transmis vers n'importe quel **point du globe**, quelle que soit la distance, sans qu'il soit nécessaire d'utiliser de telles stations intermédiaires. »
- Page 207 : « L'observation de ce phénomène merveilleux m'a fortement impressionné, car il m'a montré que la communication à n'importe quelle distance pouvait être facilement effectuée par son moyen, à condition que l'on puisse perfectionner un appareil capable de produire un changement d'état électrique ou magnétique, si petit soit-il, **dans le globe terrestre** ou dans le milieu environnant. »
- Page 208 : « Qu'il soit possible de communiquer sans fil vers n'importe quel **point du globe** avec un tel appareil n'aurait pas besoin d'être démontré, mais grâce à une découverte que j'ai faite, j'ai obtenu une certitude absolue. »

translation into english ongoing

- Page 208 : « Ils nous permettront d'atteindre de nombreux résultats spécifiques importants, impossibles autrement. Par exemple, grâce à leur utilisation, nous pouvons produire à volonté, à partir d'une station émettrice, un effet électrique dans n'importe quelle région particulière **du globe**. »

- Page 209 : « Mes mesures et mes calculs ont démontré qu'il est parfaitement possible de produire sur **notre globe**, par l'emploi de ces principes, un mouvement électrique d'une telle ampleur que, sans le moindre doute, son effet sera perceptible sur certaines de nos planètes les plus proches, comme Vénus et Mars. »

- Page 210 : « Sa réalisation pratique signifierait que l'énergie serait disponible pour les besoins de l'homme en **tout point du globe**, non pas en petites quantités comme celles qui pourraient être extraites du milieu ambiant par des machines appropriées, mais en quantités pratiquement illimitées, à partir des chutes d'eau. »

- Page 210 : « Les hommes pourraient s'installer partout, fertiliser et irriguer le sol avec peu d'effort, et transformer des déserts arides en jardins, et ainsi **le globe entier** pourrait être transformé et devenir un lieu de résidence plus adapté à l'humanité. »

- Page 210 : « Par contre, si en **un point quelconque du globe** on peut obtenir de l'énergie en quantités limitées à partir du milieu ambiant au moyen d'une machine thermique autonome ou autrement, les conditions resteront les mêmes qu'auparavant. »

(#363) Guglielmo Marconi (inventeur, prix Nobel de Physique 1909)

Marconi, autodidacte n'ayant pas fait d'études d'ingénieur ni universitaires, est considéré comme l'un des inventeurs de la radio et de la télégraphie sans fil.

Les partisans de la Terre plate citent souvent Marconi comme ayant prouvé que la Terre était plate grâce à son expérience sur la propagation des ondes dans l'atmosphère. Mais voyons ce que ce dernier dit dans sa lecture du Prix Nobel du 11 décembre 1909 disponible ici :

https://www.nobelprize.org/uploads/2018/06/marconi-lecture.pdf

Nous avons :

- Page 26 du PDF : « S'il devenait possible de transmettre des ondes dans le monde entier, on pourrait constater que l'énergie électrique circulant dans toutes les parties **du globe**… »

- Page 10 du PDF : « En ce qui concerne l'obstacle présumé de la **courbure de la Terre**, je suis d'avis que ceux qui prévoyaient des difficultés résultant de la forme de notre planète n'avaient pas suffisamment tenu compte de l'effet particulier de la connexion à la terre à la fois sur l'émetteur et sur le récepteur, connexion qui introduisait des effets de conduction qui étaient généralement négligés à cette époque. »

- Page 12 du PDF : « Les résultats obtenus à l'issue de ces essais, qui constituaient à l'époque un record de distance, semblaient indiquer que les ondes électriques produites de la manière que j'avais adoptée seraient très probablement capables de contourner la courbure de la Terre, et que donc, même à de grandes distances, telles que celles qui

translation into english ongoing

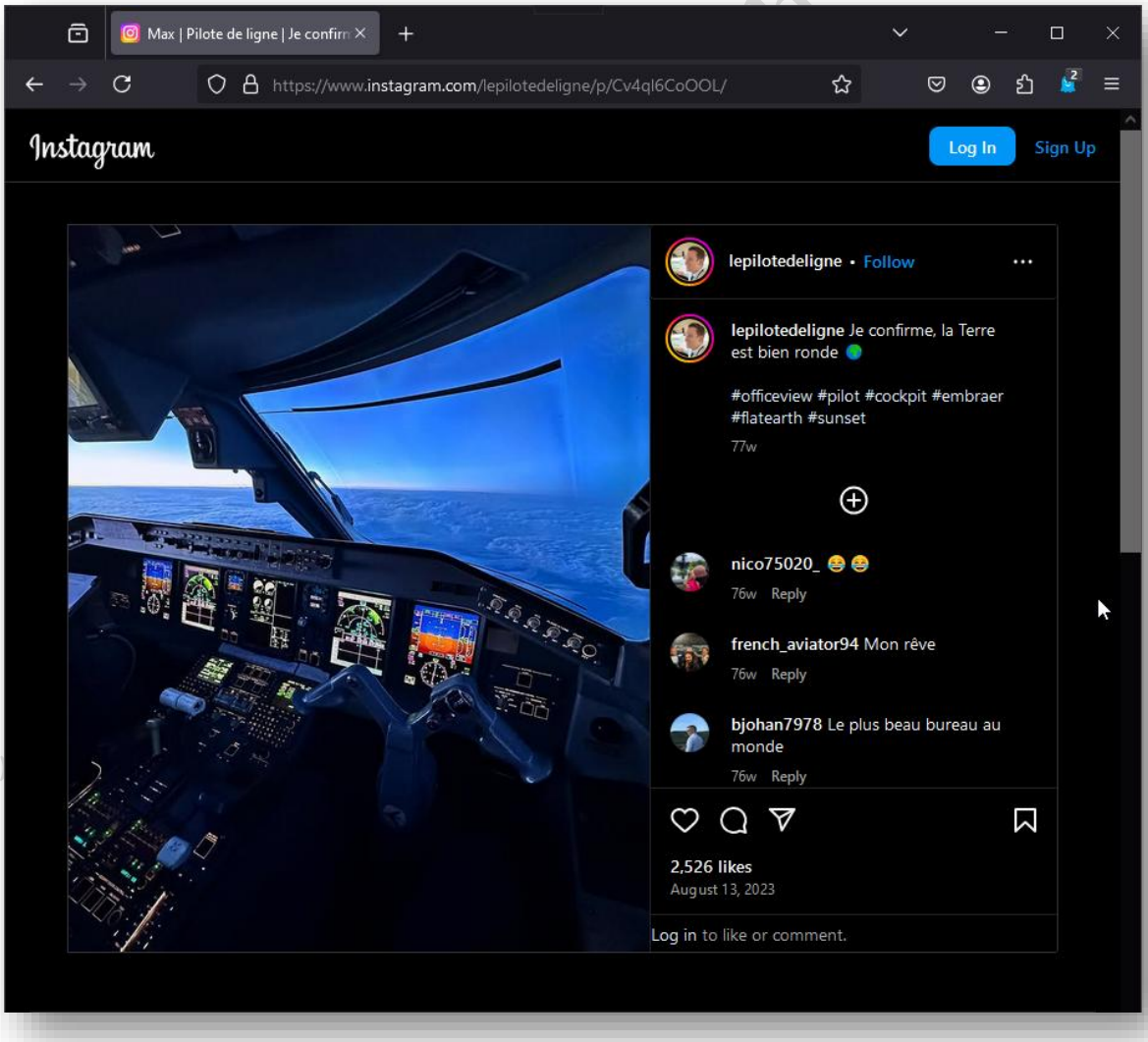
séparent l'Amérique de l'Europe, le **facteur de la courbure de la Terre ne constituerait pas un obstacle** insurmontable à l'extension de la télégraphie à travers l'espace. »

- Page 12 du PDF : « La croyance que **la courbure de la Terre n'arrêterait pas la propagation des ondes**, et le succès obtenu par les méthodes syntoniques pour empêcher les interférences mutuelles, m'ont conduit en 1900 à décider de tenter l'expérience de tester s'il serait possible ou non de détecter des ondes électriques sur… »

(#364) Maxime Fontaine (pilote de ligne)

Maxime Fontaine est Officier Pilote de Ligne chez Air France. Accessoirement il est aussi Chargé d'enseignement - Avionique, Structure et Mécanique du Vol à l'ESILV - École Supérieure d'Ingénieurs Léonard de Vinci. Il pilote depuis 2016. Tout est dit sur sa communication Instagram du 13 Août 2023 : « Je confirme, la Terre est bien ronde »

https://www.instagram.com/lepilotedeligne/p/Cv4ql6CoOOL/



(#365) Jean-Pierre Petit (ingénieur)

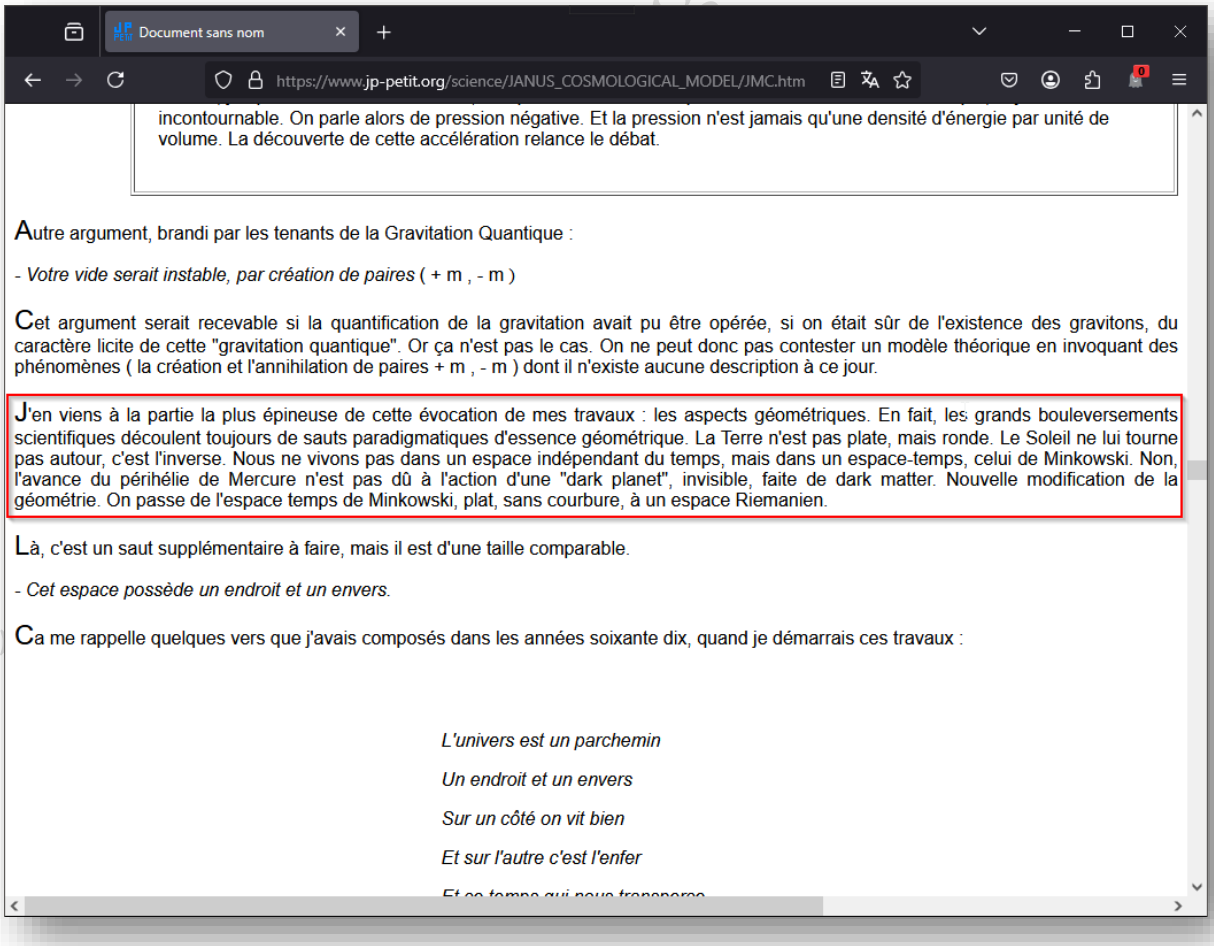
Jean-Pierre Petit est un ingénieur français né en 1937, connu pour ses travaux en astrophysique, mécanique des fluides et magnétohydrodynamique (MHD). Il a également popularisé la science à travers des bandes dessinées éducatives. Cependant, il est souvent perçu comme une figure controversée en raison de ses théories non conventionnelles, comme son modèle cosmologique Janus, qui propose l'existence de deux univers interconnectés. Ses idées, bien que novatrices, ont souvent été rejetées par les institutions scientifiques traditionnelles, ce qui a contribué à son image de marginal dans le milieu académique.

En dehors de ses contributions scientifiques, Jean-Pierre Petit a suscité des débats pour ses prises de position sur des sujets comme l'ufologie et certaines théories du complot, notamment en lien avec les attentats du 11 septembre 2001. Ces positions ont renforcé sa réputation de personnage controversé, tout en attirant un public curieux de ses idées alternatives.

Monsieur Jean-Pierre Petit tient des propos polémiques, dont nous nous désolidarisons, nous tenons à mettre cette citation car son nom est souvent cité parmi les complotistes...

Sur son blog, Jean-Pierre Petit confirme aussi que la Terre n'est pas plate :

https://www.jp-petit.org/science/JANUS_COSMOLOGICAL_MODEL/JMC.htm


Document sans nom
https://www.jp-petit.org/science/JANUS_COSMOLOGICAL_MODEL/JMC.htm
incontournable. On parle alors de pression négative. Et la pression n'est jamais qu'une densité d'énergie par unité de volume. La découverte de cette accélération relance le débat.
Autre argument, brandi par les tenants de la Gravitation Quantique :
- Votre vide serait instable, par création de paires (+ m , - m)
Cet argument serait recevable si la quantification de la gravitation avait pu être opérée, si on était sûr de l'existence des gravitons, du caractère licite de cette "gravitation quantique". Or ça n'est pas le cas. On ne peut donc pas contester un modèle théorique en invoquant des phénomènes (la création et l'annihilation de paires + m , - m) dont il n'existe aucune description à ce jour.
J'en viens à la partie la plus épineuse de cette évocation de mes travaux : les aspects géométriques. En fait, les grands bouleversements scientifiques découlent toujours de sauts paradigmatiques d'essence géométrique. La Terre n'est pas plate, mais ronde. Le Soleil ne lui tourne pas autour, c'est l'inverse. Nous ne vivons pas dans un espace indépendant du temps, mais dans un espace-temps, celui de Minkowski. Non, l'avance du périhélie de Mercure n'est pas dû à l'action d'une "dark planet", invisible, faite de dark matter. Nouvelle modification de la géométrie. On passe de l'espace temps de Minkowski, plat, sans courbure, à un espace Riemanien.
Là, c'est un saut supplémentaire à faire, mais il est d'une taille comparable.
- Cet espace possède un endroit et un envers.
Ca me rappelle quelques vers que j'avais composés dans les années soixante dix, quand je démarrais ces travaux :
L'univers est un parchemin
Un endroit et un envers
Sur un côté on vit bien
Et sur l'autre c'est l'enfer

Donc même dans la complosphère, les personnes antigouvernementales admettent la réalité qu'est le globe.

(#366) Wernher von Braun (ingénieur)

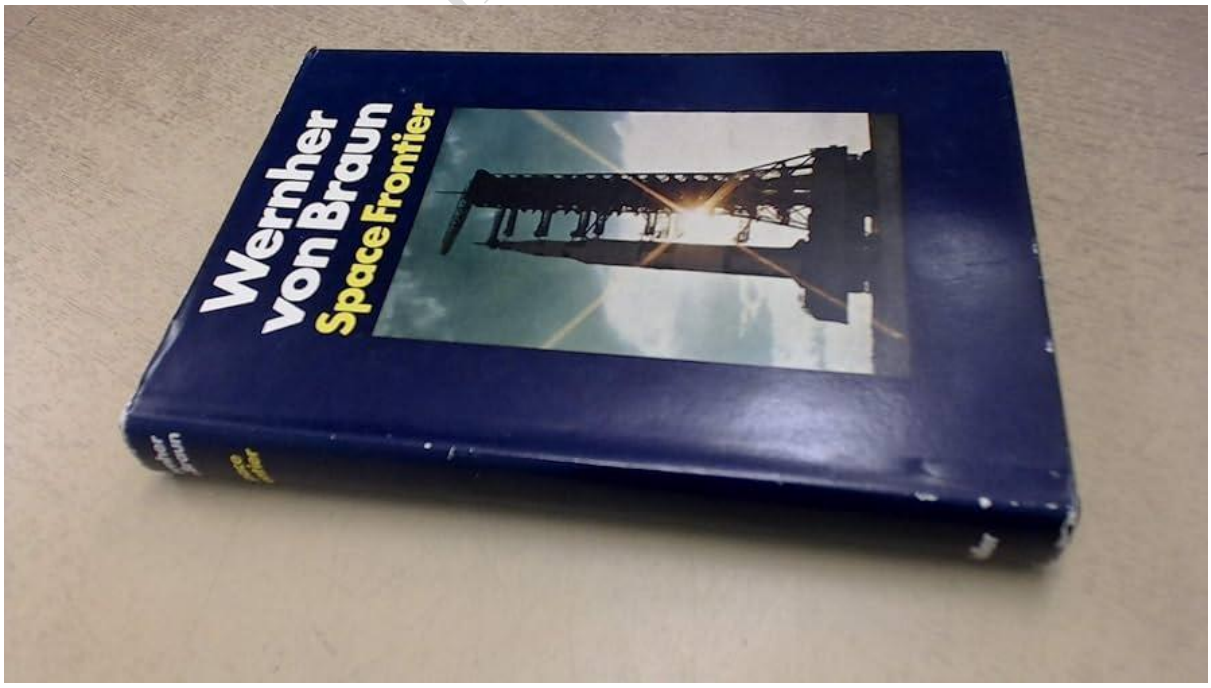
Wernher von Braun était un ingénieur allemand, issu d'une famille aristocratique de Posnanie, alors partie de l'Empire allemand. Né le 23 mars 1912 à Wirsitz (aujourd'hui Wyrzysk, en Pologne), il se passionne très tôt pour l'astronautique et rejoint dès l'adolescence la Verein für Raumschiffahrt, un groupe pionnier de la recherche sur les fusées. Ses travaux précoces sur la propulsion à ergols liquides attirent rapidement l'attention de l'armée allemande, qui l'intègre dans ses programmes de développement balistique.

Pendant la Seconde Guerre mondiale, von Braun devient l'un des principaux ingénieurs du Troisième Reich, dirigeant la mise au point de la fusée V2, premier missile balistique de l'histoire. Membre du parti nazi et officier SS, il travaille à Peenemünde, où sont développées les fusées utilisées pour bombarder Londres. Après la capitulation allemande, il est transféré aux États-Unis dans le cadre de l'opération Paperclip, où il poursuit ses recherches au service de l'armée américaine, puis de la NASA.

Aux États-Unis, von Braun joue un rôle central dans la conquête spatiale : sa fusée Juno I*place en orbite le premier satellite américain Explorer 1, et il devient l'architecte principal de la fusée Saturn V, qui permettra l'alunissage d'Apollo 11. Naturalisé américain en 1955, il reste une figure controversée en raison de son passé nazi, mais aussi un acteur majeur de l'histoire spatiale. Il meurt le 16 juin 1977 à Alexandria, en Virginie.

Dans plusieurs de ses ouvrages il mentionne le fait que la Terre est un globe et qu'il est nécessaire de prendre en compte se sphéricité pour la trajectoire des satellites.

Dans son livre *Space Frontier* :



Nous avons 11 mentions du « globe » dont par exemple à la page 10 :

into english ongoing

may be over Australia or the Pacific Ocean, while the launching was from Cape Kennedy, Florida. Radio-guidance schemes for such operations would involve a complicated globe-circling network.

An *inertial* guidance system does away with all these communication difficulties by generating the guidance commands *on board the rocket*. Such a system is entirely self-contained.

The basic idea behind an inertial-guidance system for a rocket is to measure its accelerations in three "orthogonal" (mutually per-

Ou encore à la page 48 et 49 :

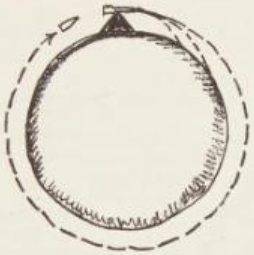
II.
FLIGHT THROUGH SPACE

Why a Satellite Stays Up and How It Comes Down

Have you wondered what makes a satellite go into an orbit? Well, imagine yourself standing on a high mountain peak, well above the atmosphere, firing a gun in a horizontal direction. (See my sketch.) The shell, after leaving the gun barrel, will first fly horizontally. But soon the earth's gravitational pull bends the trajectory downward, as in the shortest of the paths in the sketch.

Reload the gun with a more powerful charge and the shell will fly farther, as shown by the next-longer path in the sketch. Its trajectory will be less deflected because the centrifugal force (as it follows the earth's curvature) is increased by its higher speed, and more effectively counteracts the earth's gravitational pull.

If you could use a charge powerful enough to give your shell a velocity of about 4.9 miles a second (17,600 m.p.h.), *the curvature of the downward-bent trajectory would become equal to the curvature of the earth*. The shell would keep flying and flying, and about 85 minutes later you'd better take cover—because the projectile, having gone all the way around the earth, would approach you from behind and hit the breech of the gun in the rear. The shell would have traveled in a circular orbit, the globe-circling path in



my sketch. If you don't believe it, ask John Glenn, Scott Carpenter, Wally Schirra, Gordon Cooper, or any of our other astronauts.

In more general terms, this is what makes an orbit tick, and decides what kind of an orbit it will be:

A *circular* orbit occurs whenever a small mass, traveling through the gravitational field of a big one, happens to have a speed at which the centrifugal force is precisely strong enough to balance the large body's gravitational pull. This precision exists, to a high degree, in the orbiting of the moon around the earth and of the earth and Venus around the sun.

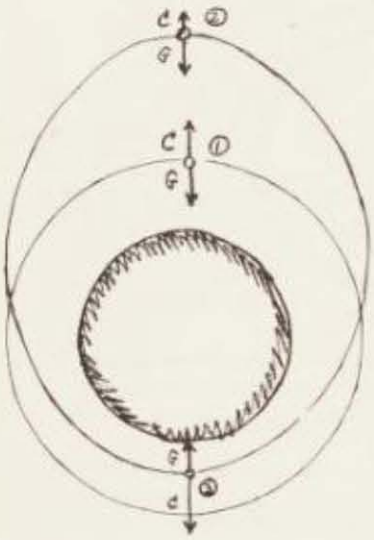
If the balance between gravitational and centrifugal force is not perfect, but the centrifugal force is strong enough to prevent a direct collision, the small body will describe an *elliptical* path around the large one. Comets follow elliptical orbits around the sun.

The second of my sketches sums up the conditions that will give rise to a circular or elliptical orbit, respectively.

A synchronous satellite (such as our Intelsat communications satellites) is a spacecraft coasting from west to east in a very high circular orbit, with a period of revolution of exactly twenty-four hours. An additional requirement is that the plane of the orbit must coincide, at least nearly, with the plane of the equator.

Since the earth likewise revolves about its axis from west to east once every twenty-four hours, and since the earth's axis is at right angles to the plane of the equator, a synchronous satellite appears to stand still forever—directly above one particular spot on the equator. (Or if it has been launched on a path somewhat inclined to the

Ou encore à la page 50 :



① Centrifugal force C equals gravitational force G
Result: circular orbit

② and ③
Centrifugal force C larger or smaller than gravitational force G.
Result: elliptical orbit

equator, as in the case of Syncom No. 2, it appears to move back and forth with a figure-8 motion above such a spot.) As is required for a twenty-four-hour period of revolution, its height is always 22,300 miles above the earth's surface.

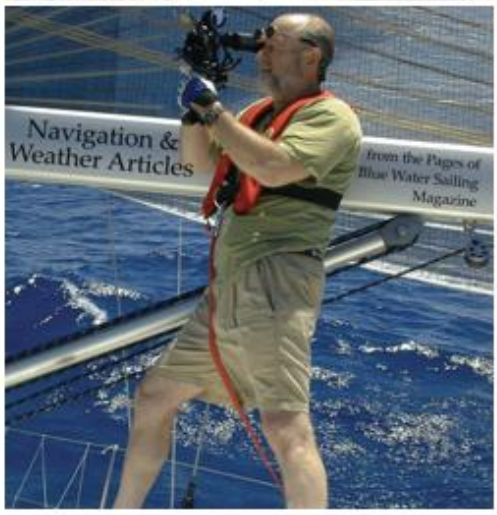
Synchronous satellites are of great interest for global communications. Because of its great distance from earth (about six earth radii), a twenty-four-hour satellite is simultaneously visible from a vast portion of the globe. For example, an Intelsat satellite "hovering" above the Amazon delta in Brazil is in direct line-of-sight contact with places as far apart as Seattle, Thule (in Greenland), London, Rome, Cape Town, Buenos Aires, Los Angeles, and parts of Antarctica. It serves as a permanent telephone or television relay station, linking North America to Europe, Africa, and Latin America.

Such a communications service uses microwaves—which are beamed up to the synchronous satellite with the help of huge ground-based dish or horn antennas. The satellite itself need not have a directional antenna. It simply feeds the received signal into a solar-

translation ongoing

Citations de navigateurs/skippeurs qui confirment le Globe

Nous avons créé cette section à la demande des partisans de la Terre plate qui nous ont mis au défi de trouver des navigateurs/skippeurs qui confirment que la Terre est un globe (et que si nous le faisions qu'ils arrêteraient de communiquer sur la Terre plate).



Donc voici une liste non-exhaustive (nos amis partisans de la Terre plate pourront vérifier ou contacter ces individus directement).

(#367) Klaus Luhta (capitaine marine marchande)

Klaus Luhta est un ancien capitaine de la marine marchande et un avocat maritime. Il possède une vaste expérience dans le guidage de navires à l'entrée et à la sortie des ports, en particulier à Baltimore. Luhta a navigué plusieurs fois autour du monde sur des cargos géants et est passé du statut de marin à celui de praticien du droit maritime. Il est également diplômé de l'Académie de la marine marchande des États-Unis et du Cleveland-Marshall College of Law. Dans *The Maritime Executive* (2024), il dit : « À l'âge de vingt-six ans, j'ai fait **le tour du globe** à bord de cargos géants. C'était génial. J'ai vu des choses que la plupart des gens ne verront jamais et j'ai grandi d'une manière que j'aurais pu imaginer. Du marin à bord d'un navire à l'avocat pratiquant le droit maritime, la mer est une vocation. Je suis ici pour partager cette vocation ».

https://www.maritime-executive.com/author/klaus-luhta

(#368) Robert Lehmann (entrepreneur, marin)

Robert Lehmann est le propriétaire de Fair Wind Fasteners, une entreprise basée à Newport, Rhode Island, spécialisée dans les fixations marines de haute qualité. Avant de fonder l'entreprise, Robert a passé de nombreuses années en mer, accumulant suffisamment de milles nautiques pour faire le tour du globe plusieurs fois. Il a commencé Fair Wind Fasteners pour répondre à la demande de fixations marines fiables, après avoir lui-même rencontré des problèmes avec des produits de mauvaise qualité. Dans un interview de *ValiantCEO* (8 octobre 2021) : « Même plus tard dans ma vie, j'ai toujours recherché de bonnes opportunités commerciales d'import/export alors que je naviguais **autour du globe** ».

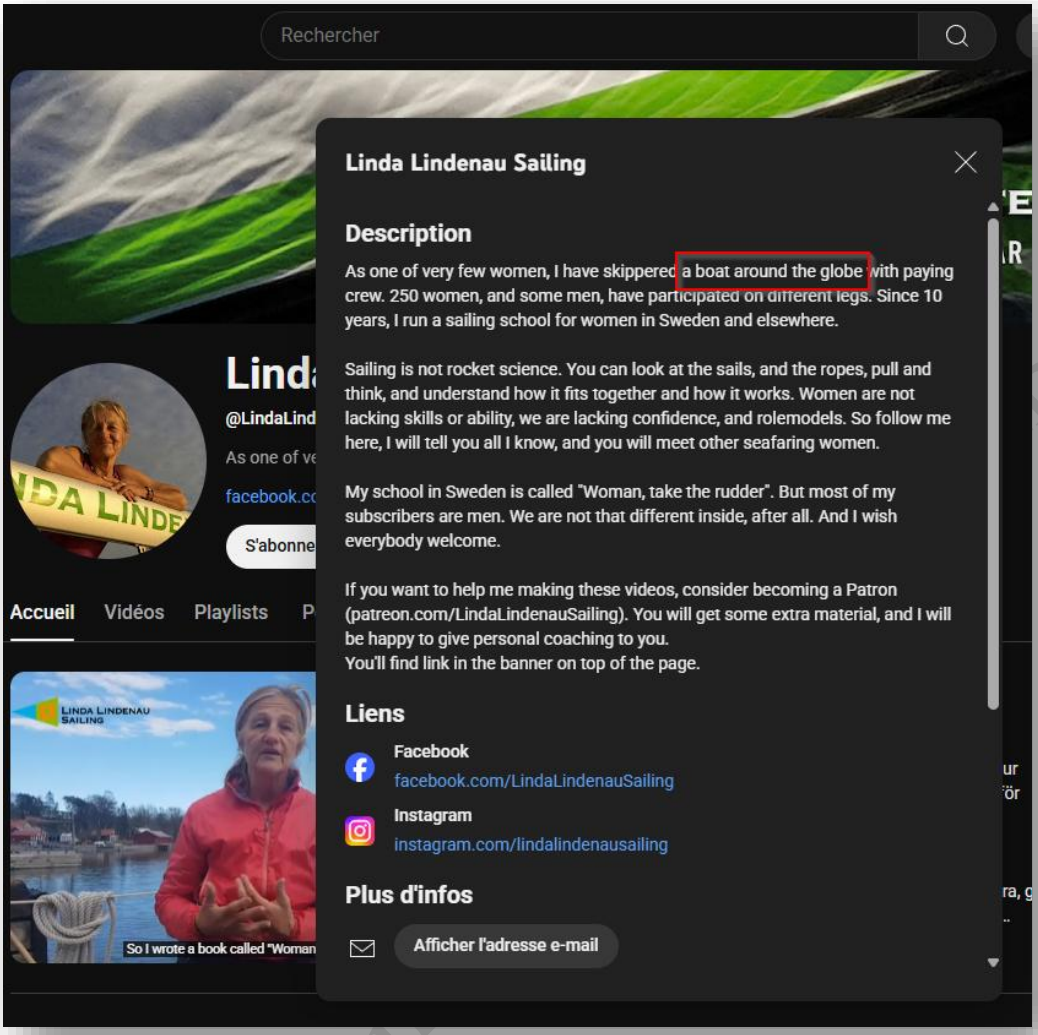
https://valiantceo.com/robert-lehmann-fair-wind-fasteners/

(#369) Linda Lindenau (navigatrice, formatrice en navigation)

Linda Lindenau est une navigatrice expérimentée et une éducatrice en voile. Elle a parcouru le monde à la voile et dirige une école de voile principalement destinée aux femmes en Suède et en Grèce. Linda partage ses connaissances et ses expériences à travers des vidéos éducatives sur YouTube, où elle aborde divers aspects de la navigation et de la vie en mer. Elle a également effectué une circumnavigation avec principalement des équipages féminins, et continue d'organiser des voyages de voile pour inspirer et former d'autres femmes à la navigation. Sur son compte Facebook, post du 25 novembre 2018 : « Je suis très fier de moi. J'ai navigué **autour du globe** avec des équipages différents, ayant des expériences et des compétences différentes, sans aucun incident grave ».

https://www.youtube.com/LindaLindenauSailing

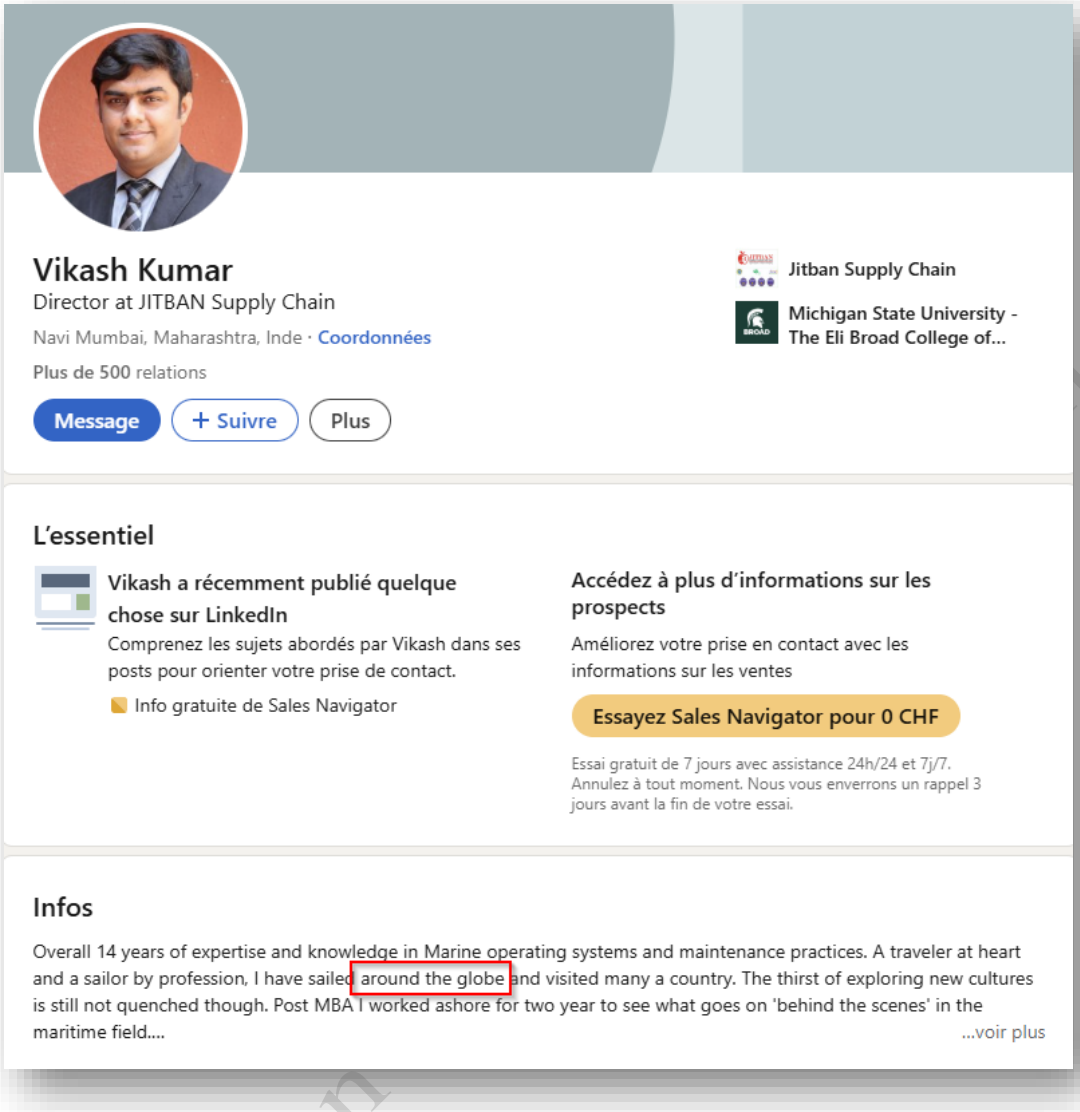
translation into english ongoing


Rechercher
Linda Lindenau Sailing
Description
As one of very few women, I have skippered a boat around the globe with paying crew. 250 women, and some men, have participated on different legs. Since 10 years, I run a sailing school for women in Sweden and elsewhere.
Sailing is not rocket science. You can look at the sails, and the ropes, pull and think, and understand how it fits together and how it works. Women are not lacking skills or ability, we are lacking confidence, and rolemodels. So follow me here, I will tell you all I know, and you will meet other seafaring women.
My school in Sweden is called "Woman, take the rudder". But most of my subscribers are men. We are not that different inside, after all. And I wish everybody welcome.
If you want to help me making these videos, consider becoming a Patron (patreon.com/LindaLindenauSailing). You will get some extra material, and I will be happy to give personal coaching to you.
You'll find link in the banner on top of the page.
Liens
Facebook
facebook.com/LindaLindenauSailing
Instagram
instagram.com/lindalindenausailing
Plus d'infos
Afficher l'adresse e-mail
Accueil
Vidéos
Playlists
@LindaLind
facebook.cc
S'abonne
So I wrote a book called "Woman

(#370) Vikash Kumar (entrepreneur, ingénieur maritime en chef)

Vikash Kumar est le fondateur et directeur de JITBAN Supply Chain Private Limited, une entreprise spécialisée dans la chaîne d'approvisionnement durable pour les produits agricoles[12]. Il possède une vaste expérience internationale en tant que surintendant maritime et ingénieur en chef, ayant travaillé avec des géants de l'industrie comme Dole et Chiquita[2]. JITBAN Supply Chain, basée à Patna, Inde, se concentre sur la fourniture de fruits sans produits chimiques, avec des installations de mûrissage et de stockage à froid. Sur son profil LinkedIn : « Au total, 14 années d'expertise et de connaissances dans les systèmes d'exploitation et les pratiques de maintenance maritimes. Voyageur dans l'âme et marin de profession, j'ai navigué **autour du globe** et visité de nombreux pays. »

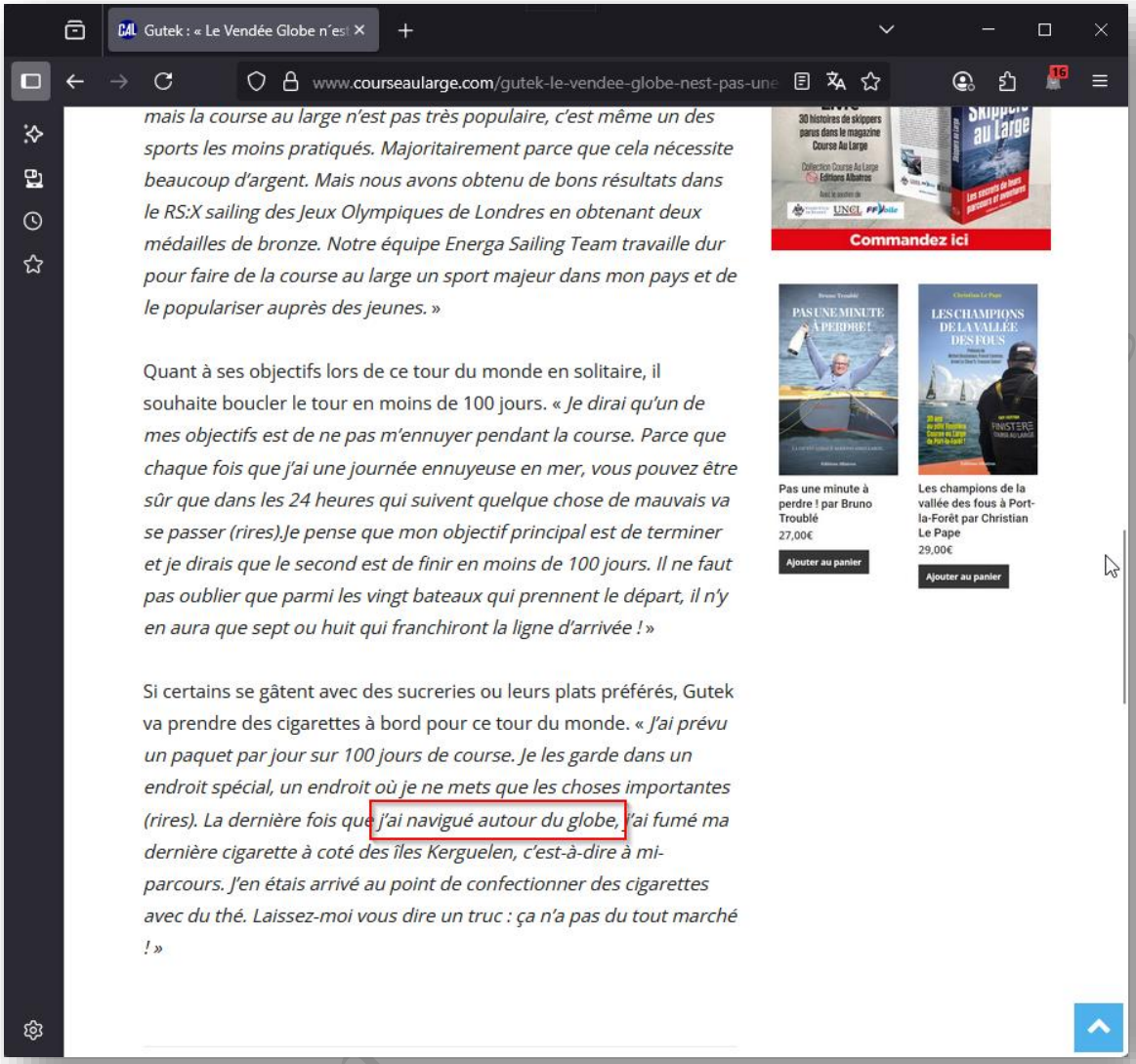
https://www.linkedin.com/in/vikash-kumar-8a275233/


Vikash Kumar
Director at JITBAN Supply Chain
Navi Mumbai, Maharashtra, Inde · Coordonnées
Plus de 500 relations
Message
+ Suivre
Plus
Jitban Supply Chain
Michigan State University - The Eli Broad College of...
L'essentiel
Vikash a récemment publié quelque chose sur LinkedIn
Comprenez les sujets abordés par Vikash dans ses posts pour orienter votre prise de contact.
Info gratuite de Sales Navigator
Accédez à plus d'informations sur les prospects
Améliorez votre prise en contact avec les informations sur les ventes
Essayez Sales Navigator pour 0 CHF
Essai gratuit de 7 jours avec assistance 24h/24 et 7j/7. Annulez à tout moment. Nous vous enverrons un rappel 3 jours avant la fin de votre essai.
Infos
Overall 14 years of expertise and knowledge in Marine operating systems and maintenance practices. A traveler at heart and a sailor by profession, I have sailed around the globe and visited many a country. The thirst of exploring new cultures is still not quenched though. Post MBA I worked ashore for two year to see what goes on 'behind the scenes' in the maritime field....
...voir plus

(#371) Zbigniew Gutkowski (navigateur/compétiteur professionnel)

Zbigniew Gutkowski, surnommé « Gutek », est un navigateur professionnel polonais né le 24 juin 1973 à Gdańsk. Il est connu pour être le premier Polonais à participer à des courses de voile autour du monde telles que la VELUX 5 Oceans Race et le Vendée Globe. En 2012, il a été le skippeur de l'IMOCA Energa. Gutkowski a également participé à de nombreuses autres compétitions de voile, obtenant des résultats notables comme une deuxième place dans la Velux 5 Oceans en 2010. En plus de ses exploits en voile, il est capitaine de yacht, capitaine de bateau à moteur, plongeur et radio-opérateur. Interview sur CourseAuLarge.com le 31 octobre 2012 : « La dernière fois que j'ai navigué **autour du globe**, j'ai fumé ma dernière cigarette à coté des îles Kerguelen, c'est-à-dire à mi-parcours. ».

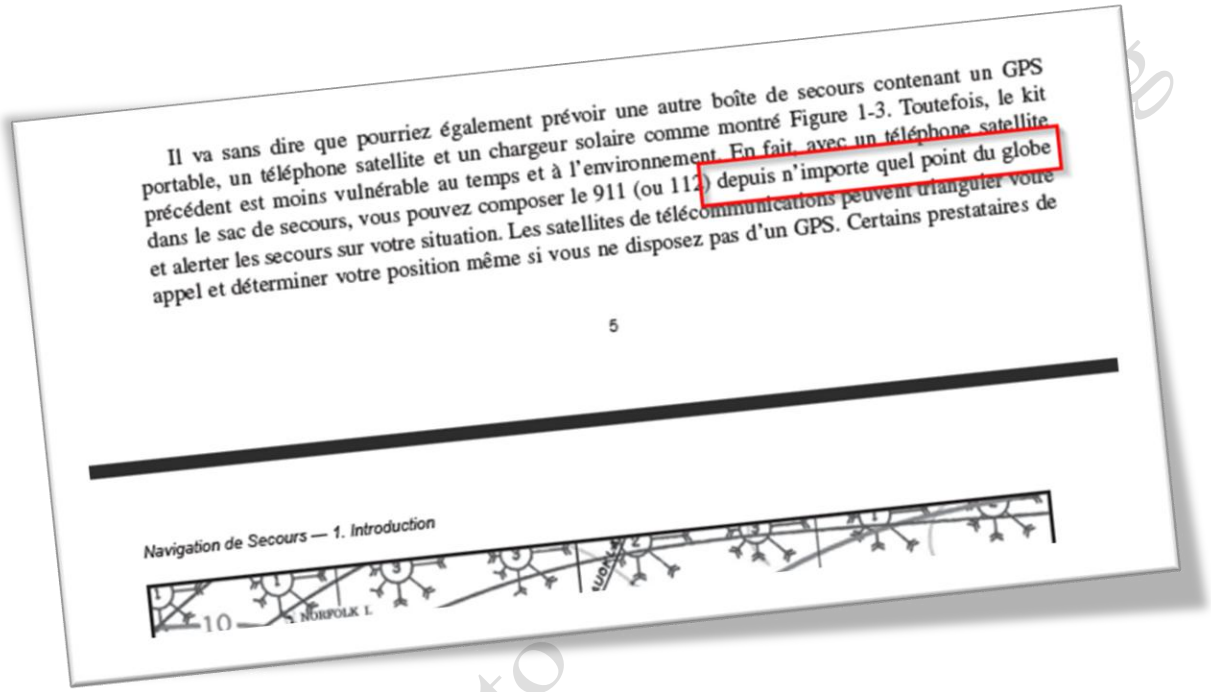
https://www.courseaularge.com/gutek-le-vendee-globe-nest-pas-une-fin-en-soi.html


Gutek : « Le Vendée Globe n'est
www.courseaularge.com/gutek-le-vendee-globe-nest-pas-une
mais la course au large n'est pas très populaire, c'est même un des sports les moins pratiqués. Majoritairement parce que cela nécessite beaucoup d'argent. Mais nous avons obtenu de bons résultats dans le RS:X sailing des Jeux Olympiques de Londres en obtenant deux médailles de bronze. Notre équipe Energa Sailing Team travaille dur pour faire de la course au large un sport majeur dans mon pays et de le populariser auprès des jeunes. »
Quant à ses objectifs lors de ce tour du monde en solitaire, il souhaite boucler le tour en moins de 100 jours. « Je dirai qu'un de mes objectifs est de ne pas m'ennuyer pendant la course. Parce que chaque fois que j'ai une journée ennuyeuse en mer, vous pouvez être sûr que dans les 24 heures qui suivent quelque chose de mauvais va se passer (rires).Je pense que mon objectif principal est de terminer et je dirais que le second est de finir en moins de 100 jours. Il ne faut pas oublier que parmi les vingt bateaux qui prennent le départ, il n'y en aura que sept ou huit qui franchiront la ligne d'arrivée ! »
Si certains se gâtent avec des sucreries ou leurs plats préférés, Gutek va prendre des cigarettes à bord pour ce tour du monde. « J'ai prévu un paquet par jour sur 100 jours de course. Je les garde dans un endroit spécial, un endroit où je ne mets que les choses importantes (rires). La dernière fois que j'ai navigué autour du globe, j'ai fumé ma dernière cigarette à coté des îles Kerguelen, c'est-à-dire à mi-parcours. J'en étais arrivé au point de confectionner des cigarettes avec du thé. Laissez-moi vous dire un truc : ça n'a pas du tout marché ! »
Commandez ici
Pas une minute à perdre ! par Bruno Troublé
27,00€
Ajouter au panier
Les champions de la vallée des fous à Port-la-Forêt par Christian Le Pape
29,00€
Ajouter au panier

(#372) David Burch (navigateur/compétiteur professionnel)

David Burch est l'auteur de cours et directeur d'une école de navigation. Il a plus de 70 000 milles d'expérience océanique, allant de la lisière des glaces de l'Arctique à Tahiti et à l'Australie dans le Pacifique et de New York à Panama dans l'Atlantique. Il a traversé le Pacifique jusqu'à Hawaï dix fois, a remporté trois fois la course de yachts Victoria-Maui et a établi en 1984 le record de temps écoulé pour ce passage pour les navires de moins de 38 pieds de long (le record a duré seize ans, mais a été dépassé lors de la course de 2000). En bateaux à moteur, il a livré un bateau de pêche de 65 pieds de New York à Seattle, via Panama et a effectué de nombreuses livraisons côtières entre WA et CA, AK et le Mexique. Il a navigué sur le seul navire américain (Cassiopeia de 72 pieds) lors de la course de yachts Sydney-Hobart de 1993, ravagée par la tempête, et a depuis navigué sur ce navire lors de la Vic Maui and Swiftsure Lightship Classic de 1996, lorsqu'il a remporté la première place au classement général de cette dernière. Il est l'auteur de quinze livres sur la navigation maritime et ses articles de magazine ont été publiés dans Cruising World, Ocean Navigator, Sailing et Sea Kayaker. Sa chronique « Burch at the Helm » est parue dans le magazine BlueWater Sailing de 2009 à

2015. Ses livres comprennent Radar for Mariners ; Emergency Navigation ; Modern Marine Weather ; Fundamentals of Kayak Navigation ; The Barometer Handbook ; How to Use Plastic Sextants. Ses manuels et cahiers d'exercices sur la navigation intérieure et côtière et sur la navigation céleste sont utilisés par de nombreuses écoles, dans tout le pays. Une liste complète des livres est disponible sur Amazon Author Central. Dans son livre *Navigation de Secours* de 279 pages, publié aux éditions StarPath confirme des centaines de fois dans cet ouvrage que la Terre est un globe :



Il va sans dire que pourriez également prévoir une autre boîte de secours contenant un GPS portable, un téléphone satellite et un chargeur solaire comme montré Figure 1-3. Toutefois, le kit précédent est moins vulnérable au temps et à l'environnement. En fait, avec un téléphone satellite dans le sac de secours, vous pouvez composer le 911 (ou 112) depuis n'importe quel point du globe et alerter les secours sur votre situation. Les satellites de télécommunications peuvent trianguler votre appel et déterminer votre position même si vous ne disposez pas d'un GPS. Certains prestataires de

5

Navigation de Secours — 1. Introduction

Donc nous avons bien plusieurs navigateurs qui confirment que la Terre n'est pas plate !

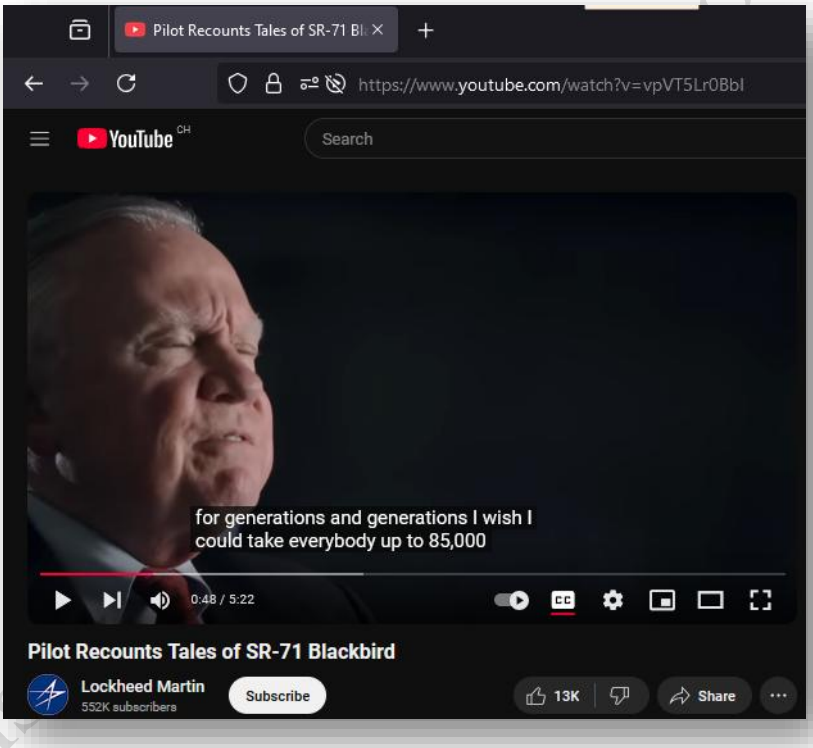
translation into

Vidéos/Interviews avec scientifiques, pilotes, marins, ingénieurs confirmant la courbure ou le globe

Les partisans de la Terre plate dans leur malhonnêteté habituelle aiment bien couper ou monter des vidéos où ils font croire à ceux qui veulent bien les écouter que des scientifiques, ingénieurs ou marins confirment que la Terre est plate (ce qui n'est évidemment jamais le cas !). Nous allons donc leur renvoyer la balle avec des vidéos originales et sourcées avec time-code de personnes du même acabit qui affirment explicitement le contraire[13] !

D'abord rappelons le lien suivant du colonel Buz Carpenter, diplômé de l'Académie de l'USAF (United States Air Force), pilote du Lockheed SR[14]-71 (Blackbird) dans l'US Air Force dans une interview vidéo de Lockheed Martin en 2013 : « *J'aimerais pouvoir emmener tout le monde jusqu'à 85 000 pieds parce qu'on peut voir à 350 miles dans une direction.* ***On voit la courbure de la Terre*** ».

https://youtu.be/vpVT5Lr0BbI?t=46



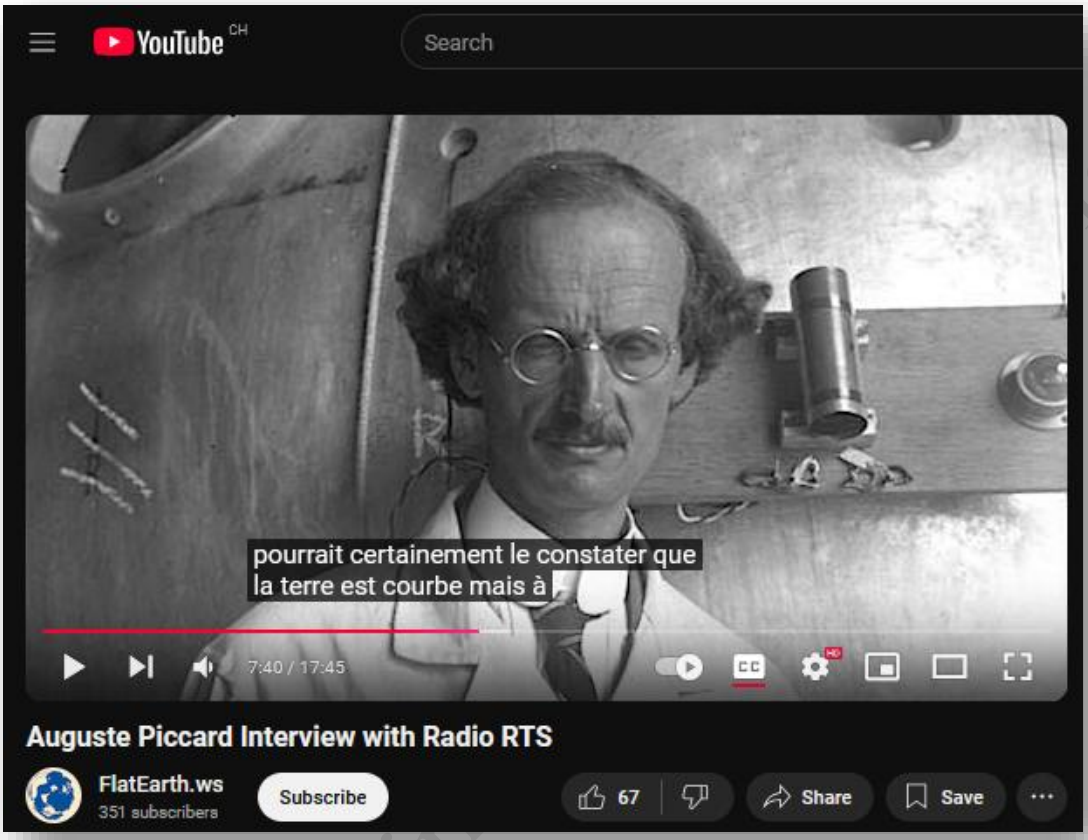
(#373) Auguste Piccard (doctorat en physique de l'ETHZ, Suisse)

Auguste Piccard Écouter, né à Bâle le 28 janvier 1884 et mort à Chexbres le 24 mars 1962, est un physicien, aéronaute et océanaute suisse. Dans son interview à la RTS du 21 Juillet 1954 au micro d'André Savoy, il confirme qu'avec une règle il aurait pu constater que la Terre est courbe mais que à travers les minuscules hublots qu'il avait dans sa capsule il n'était pas

[13] Évidemment dans le domaine scientifique nous savons que l'opinion d'un scientifique ou d'ingénieur est un niveau d'évidence de seulement 1 sur une échelle de 15…
[14] SR signifiant: Strategic Reconnaissance

possible de remarquer la courbure (puisqu'il était à seulement 15'781 mètres et que les hublots faisaient seulement 8 centimètres de diamètre) :

https://www.youtube.com/watch?v=qjVuDr18N-M&t=448s



Source originale :

https://www.rts.ch/archives/radio/divers/emission-sans-nom/3365397-stratosphere-vaincue.html

(#374) Jean-Pierre Goux (mathématicien, ingénieur)

Jean-Pierre Goux, est ingénieur diplômé de l'École Nationale Supérieure de Techniques Avancées (ENSTA Paris) en 19962 et titulaire d'un DEA de Sorbonne Université dans sa conférence TeDX décrit pendant presque 17 minutes la rotondité de la Terre :

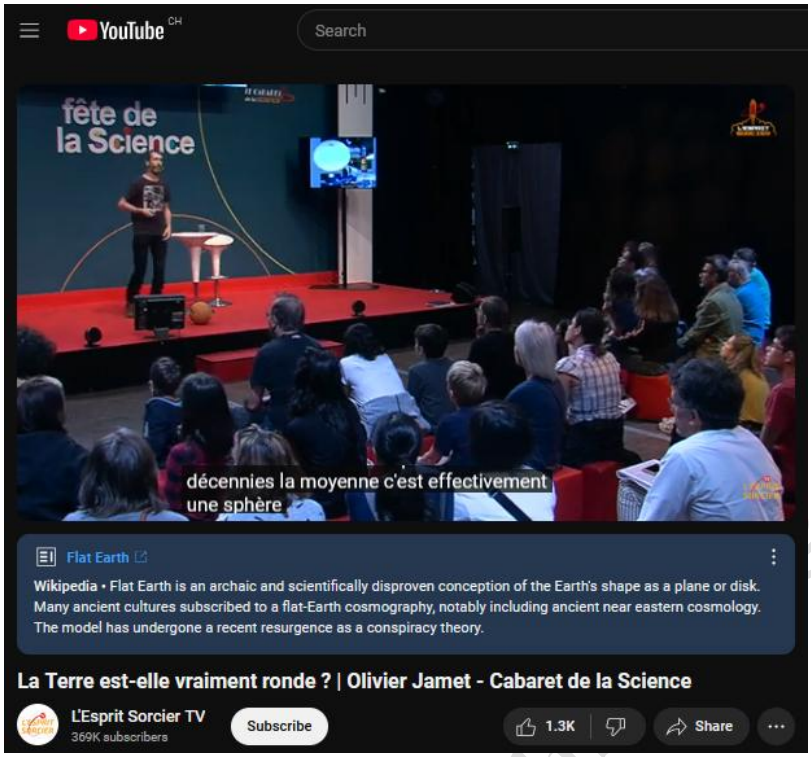
https://youtu.be/Boe8F09OvWI?t=719

(#375) Olivier Jamet (mathématicien, ingénieur)

Olivier Jamet, PhD en Géodésie, a dirigé jusqu'en 2018 le laboratoire de recherche en géodésie de l'IGN, qui accueille la détermination du repère international de référence terrestre (ITRF). Il a gardé de cette expérience une vision large des techniques de géodésie spatiale. Dans sa fonction de délégué adjoint à l'IGN, il est particulièrement en charge des questions relatives aux références géodésiques, à la localisation et à la mesure des déformations.

https://youtu.be/G8xj6CXuj5Y?t=337

translation into eng


YouTube CH
Search
fête de
la Science
décennies la moyenne c'est effectivement
une sphère
Flat Earth
Wikipedia • Flat Earth is an archaic and scientifically disproven conception of the Earth's shape as a plane or disk. Many ancient cultures subscribed to a flat-Earth cosmography, notably including ancient near eastern cosmology. The model has undergone a recent resurgence as a conspiracy theory.
La Terre est-elle vraiment ronde ? | Olivier Jamet - Cabaret de la Science
L'Esprit Sorcier TV
369K subscribers
Subscribe
1.3K
Share

(#367) Alain Riazuelo (astrophysicien, chargé de recherches CNRS, à l'institut d'astrophysique de Paris)

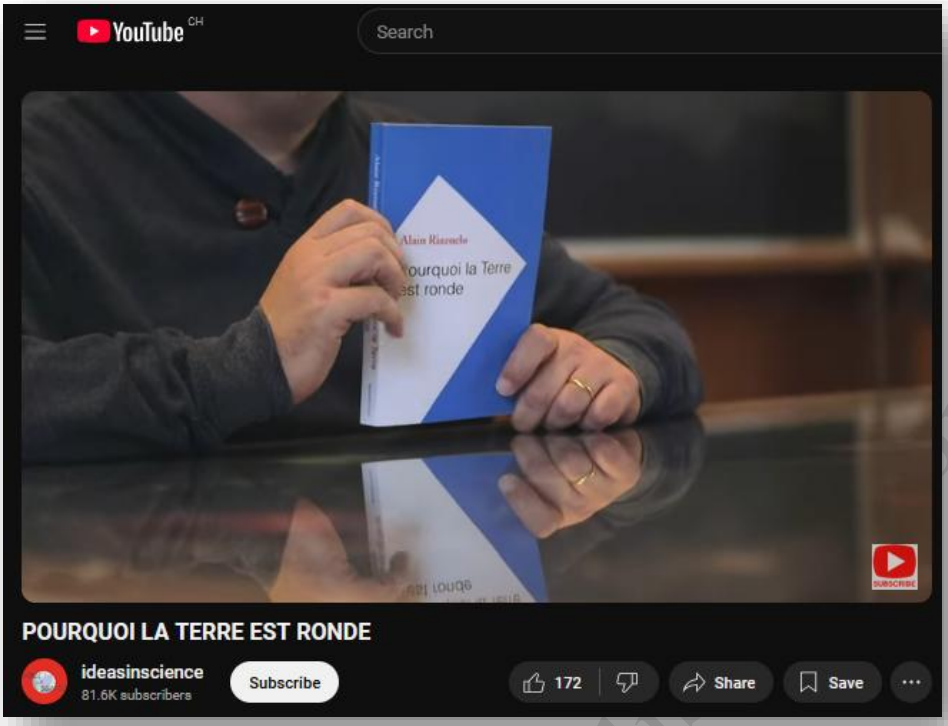
Alain Riazuelo, né le 8 octobre 1973 à Marseille, est un astrophysicien français chercheur à l'Institut d'astrophysique de Paris (IAP)2 et ambassadeur du CNRS. Il est reçu à l'École polytechnique en 1993. Il termine un stage dont le sujet est l'évaporation des trous noirs. Alain Riazuelo commence ensuite un DEA « Astrophysique et techniques spatiales » à l'université Paris XI et soutient une thèse sur les mécanismes d'émission radio des pulsars avant d'attaquer une thèse sur la signature de divers modèles d'Univers primordial dans les anisotropies du rayonnement fossile.

Alain Riazuelo travaille par la suite pour le Département de physique théorique de l'université de Genève, au CEA, puis à l'Institut d'astrophysique de Paris.

Devenu médiatique à cette période, c'est en 2012 qu'il reçoit le Prix spécial « Astronomie en société » du conseil de la Société française d'astronomie et d'astrophysique (SF29A). Depuis cette période, il intervient dans différents médias français pour faire de la vulgarisation scientifique et il étudie les trous noirs à Paris-Saclay. Il a écrit un petit livre non illustré « Pourquoi la Terre est ronde ».

Dans la vidéo ci-dessous de 15 minutes, il explique pourquoi la Terre est ronde :

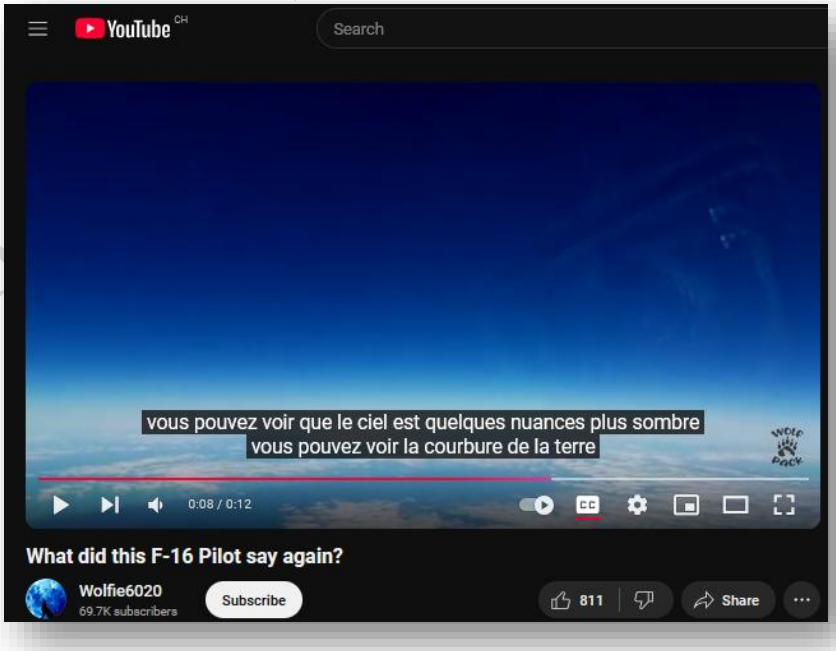
translation not ongoing



(#376) Hasard Lee (pilote de chasse F16 et F35)

Hasard Lee est un pilote de chasse F-35, auteur et créateur de contenu avec l'une des plus grandes chaînes de défense sur YouTube. Voici ce qu'il dit sur la vidéo disponible ici :

https://www.youtube.com/watch?v=vkr4KZg8IpI



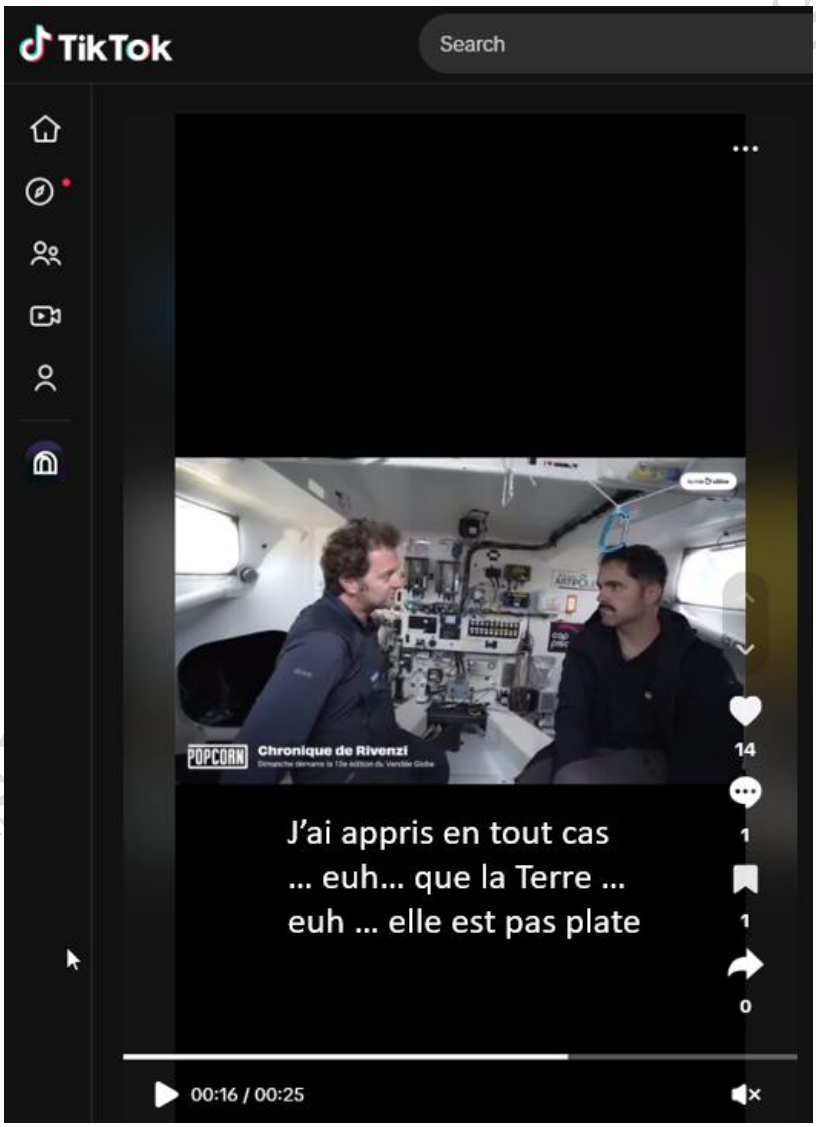
La phrase complète étant : « *…en postcombustion maximale accéléré à 1.4 mach à 50 000 pieds vous pouvez voir que le ciel est quelque nuance plus sombre, vous pouvez voir la courbure de la Terre.* »

(#377) Arnaud Boissières (navigateur/compétiteur professionnel)

Arnaud Boissières, né le 20 juillet 1972 à Bordeaux (Gironde), est un navigateur et un skippeur professionnel français. En 2021, il est le seul skippeur à avoir terminé consécutivement quatre Vendée Globe (2009, 2013, 2017, 2021).

Dans un interview disponible en suivant le lien ci-dessous il confirme que la Terre n'est pas plate :

https://www.tiktok.com/@_hamzatt_69/video/7435367114665413920



Ou ici sur YouTube :

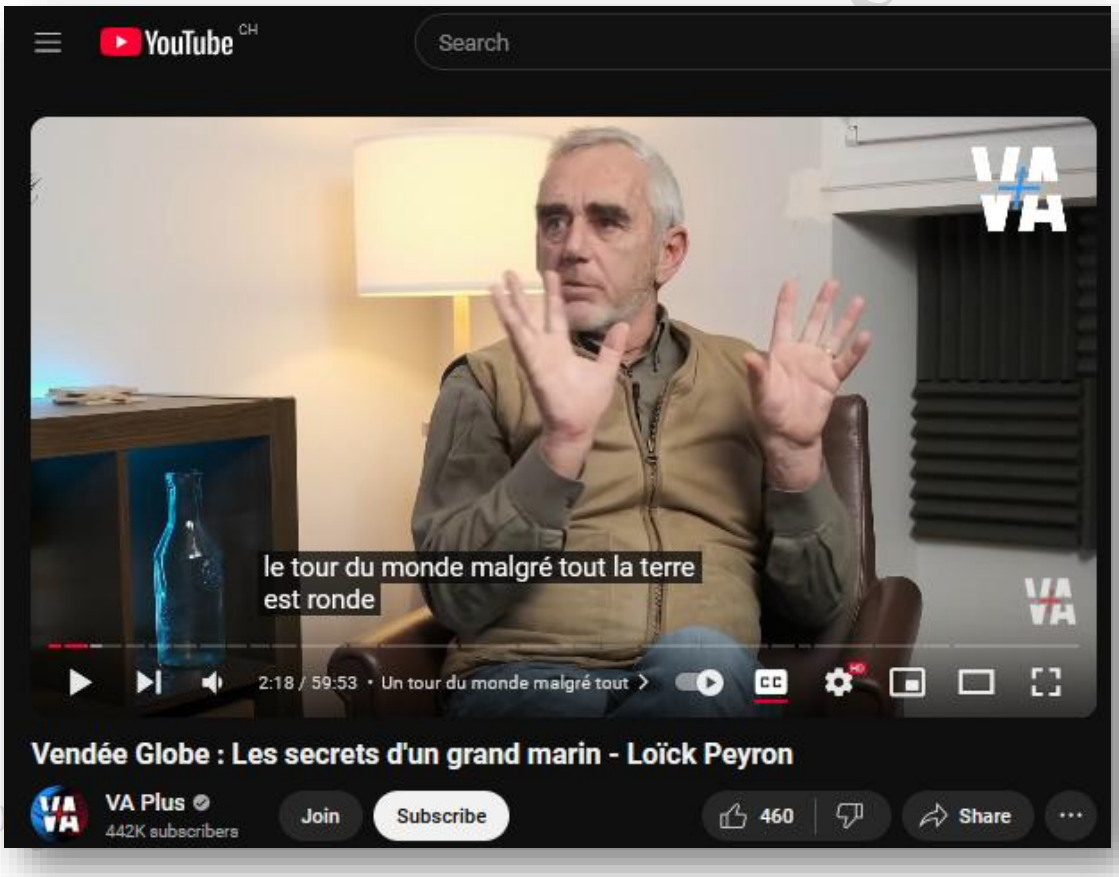
https://youtu.be/hAC1prqMRDw?t=285

(#378) Loïck Peyron (navigateur/compétiteur professionnel)

Loïck Peyron, né le 1er décembre 1959 à Nantes, est un navigateur français. Frère cadet de Bruno Peyron et ainé de Stéphane Peyron, le benjamin, il a notamment remporté trois fois la Transat anglaise, quatre fois le Championnat du monde ORMA, deux fois la Transat Jacques-Vabre, une fois la Barcelona World Race et la Route du Rhum ainsi que huit fois le trophée Clairefontaine. À partir de 2011, il prépare la Coupe de l'America 2013 avec Energy Team puis avec Artemis Racing. Il a aussi été détenteur pendant 5 ans du Trophée Jules-Verne. Il l'a conquis en janvier 2012, en 45 jours 13 heures 42 minutes et 53 secondes à bord du trimaran Maxi Banque Populaire V, avant de le céder à Francis Joyon en janvier 2017, qui établit alors un nouveau temps de référence en 40 jours 23 heures 30 minutes et 30 secondes à bord du trimaran IDEC Sport.

Dans un interview sur VA Plus disponible ici à 2 minutes et 18 secondes :

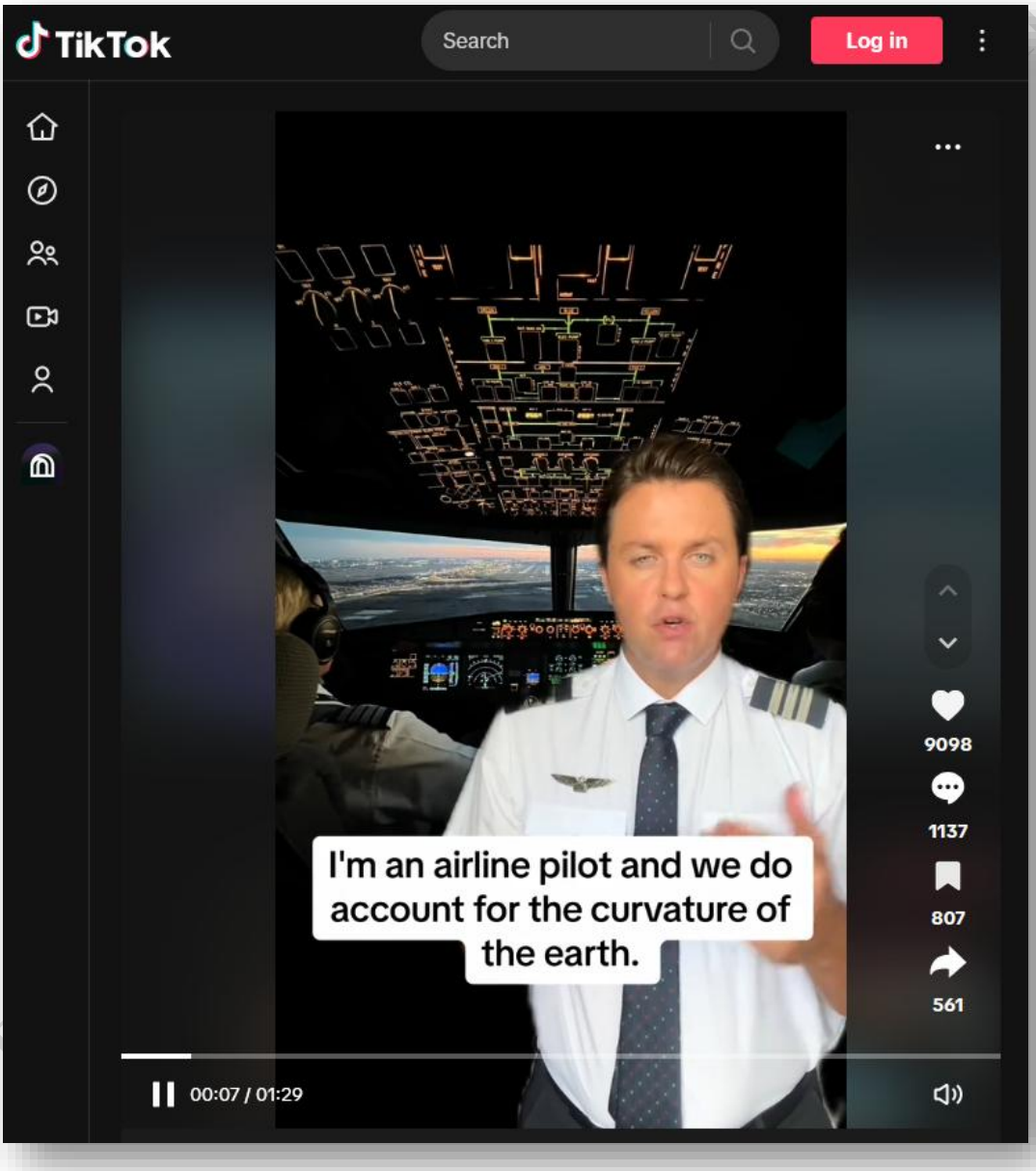
https://youtu.be/FTSoIOdPPq0?t=136



(#379) Gary Baumgardner (pilote de ligne)

Gary Baumgardner (voir sa page LinkedIn https://www.linkedin.com/in/gary-baumgardner-446596138) est pilote de ligne depuis 2007 actif aux États-Unis et confirme dans sa vidéo sur TikTok qu'ils prennent en comptent la courbure de la Terre lors de le leurs trajets commerciaux et il explique aussi comment calculer l'angle total de correction à partir des instruments de navigation :

https://www.tiktok.com/@garybpilot/video/7399301950178659615?_r=1&_t=8sckTp3Ytc6



Voici la traduction du sous-titre en français : « Je suis un pilote de ligne et nous prenons en compte la courbure de la Terre ».

(#380) Lucas Fanjaud (pilote commercial et instructeur de vol)

Lucas Fanjaud (voir sa page LinkedIn https://ca.linkedin.com/in/lucas-fanjaud-42557b2a6/) est pilote commercial depuis 2024 et instructeur au Canada et confirme dans sa vidéo sur TikTok que les avions ne suivent pas une trajectoire à cap constant (loxodromie) mais une orthodromie (grand cercle) car la Terre est sphérique et ce pour des raisons de coûts de vols (distance et temps).

https://www.tiktok.com/@french_aero_/video/7171871703805529350?_t=ZN-8tdJTR2nZ6U&_r=1

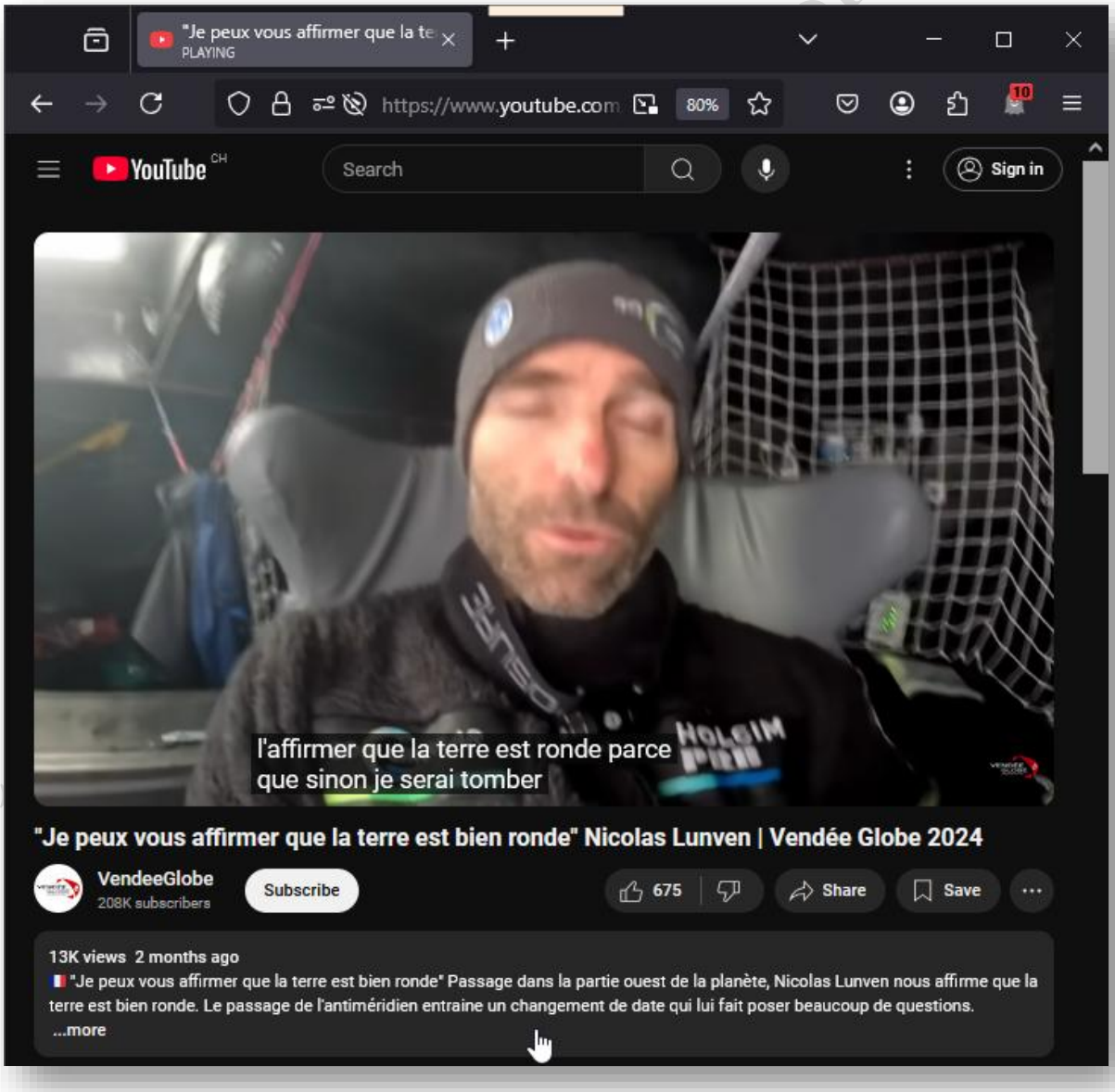
(#381) Nicolas Lunven (navigateur/compétiteur professionnel)

Nicolas Lunven est un navigateur français né le 28 novembre 1982 à Vannes, en Bretagne. Il a remporté deux fois la Solitaire du Figaro, en 2009 et 2017, et a participé à plusieurs éditions de la Volvo Ocean Race. Lunven a également pris part à diverses courses prestigieuses telles que la Transat Jacques Vabre et la Rolex Sydney-Hobart. En 2021, il a remporté The Ocean Race Europe avec l'équipe Racing for the Planet.

En 2024, lors de sa première participation au Vendée Globe, Nicolas Lunven établit un nouveau record de distance parcourue en 24 heures en solitaire sur monocoque, avec 546.6 miles nautiques (environ 1012 kilomètres) parcourus à bord de l'IMOCA Holcim-PRB.

Il confirme en direct que la Terre est bien ronde pendant sa Vendée Globe :

https://www.youtube.com/watch?v=pBw0DAARpFM&themeRefresh=1


"Je peux vous affirmer que la te
PLAYING
https://www.youtube.com
80%
YouTube CH
Search
Sign in
l'affirmer que la terre est ronde parce
que sinon je serai tomber
HOLCIM
"Je peux vous affirmer que la terre est bien ronde" Nicolas Lunven | Vendée Globe 2024
VendeeGlobe
208K subscribers
Subscribe
675
Share
Save
13K views 2 months ago
"Je peux vous affirmer que la terre est bien ronde" Passage dans la partie ouest de la planète, Nicolas Lunven nous affirme que la terre est bien ronde. Le passage de l'antiméridien entraine un changement de date qui lui fait poser beaucoup de questions.
...more

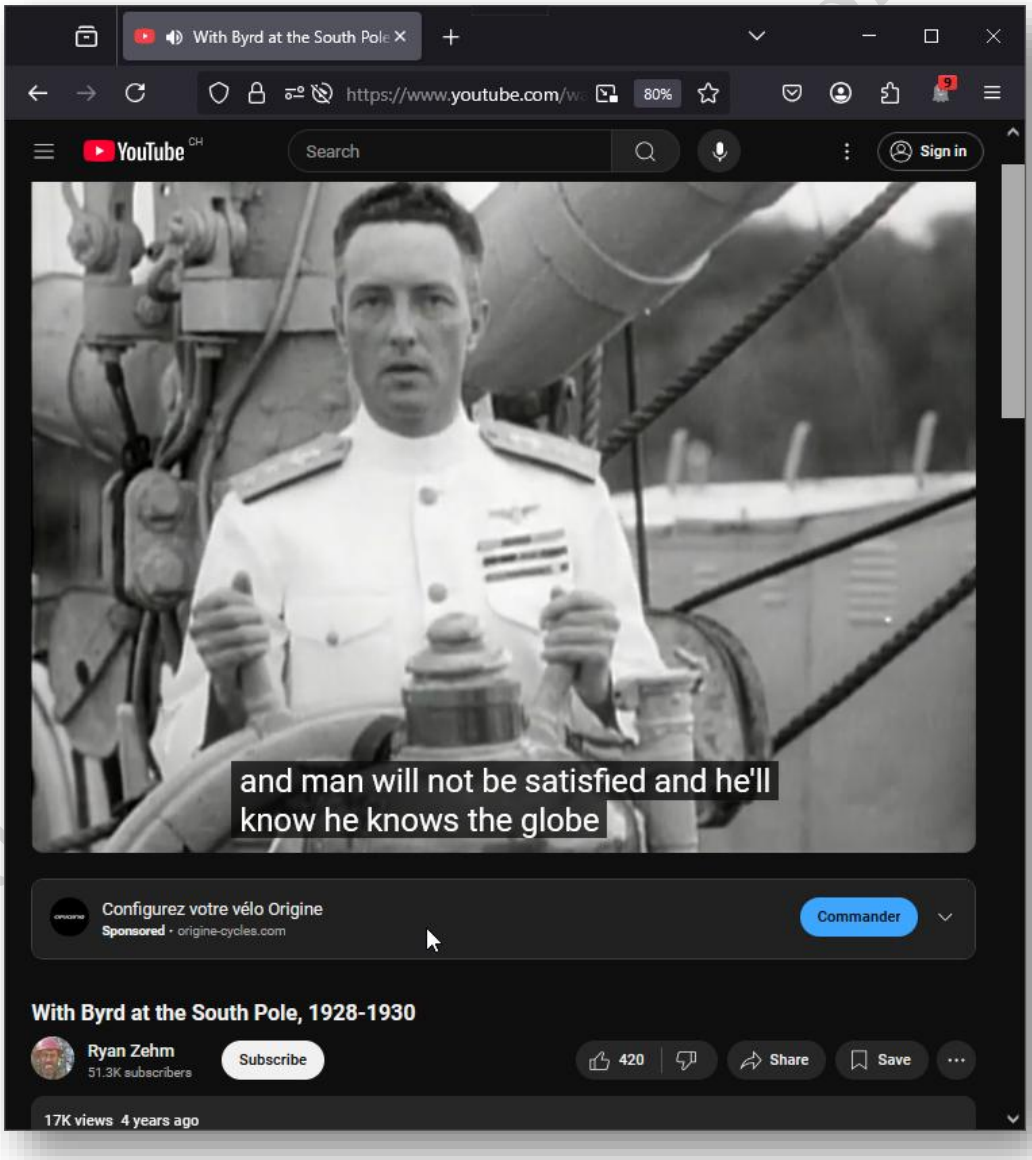
(#382) Amiral Bird (aviateur/officier navigateur

L'Amiral Richard Evelyn Byrd (1888-1957) était un explorateur polaire américain et un aviateur pionnier. Il est célèbre pour ses expéditions en Antarctique et pour avoir prétendu être le premier à atteindre les pôles Nord et Sud par avion. Bien qu'il y ait des controverses sur son vol au pôle Nord, ses contributions à l'exploration polaire et à l'aviation restent remarquables. Byrd a également découvert le mont Sidley, le plus grand volcan dormant de l'Antarctique, et a reçu de nombreuses distinctions, dont la Médaille d'honneur.

Dans son introduction de 1950 dans le film de la Paramount suite à sa première expédition en Antarctique et son survol du pôle Sud disponible ici :

https://www.youtube.com/watch?v=VaFJmih3t0E

il mentionne plusieurs fois par ses paroles dans l'interview que le Terre est un globe et que l'antarctique est un continent qui a environ la taille des États-Unis et du Mexique réunis :



(#383) Pierre-Henri Chuet (ancien pilote de chasse franco-canadien)

Pierre-Henri « Até Chuet » est un ancien pilote de chasse franco-canadien de l'aéronavale française, connu pour ses plus de 200 appontages sur porte-avions et ses missions de combat au-dessus de l'Irak. Victime d'un AVC à 31 ans, il s'est reconverti en conférencier, auteur et consultant en leadership, fondant la méthode D.BRIEF pour transposer les techniques de pilotage à la vie professionnelle. Très actif sur YouTube et dans les médias, il partage ses analyses géopolitiques et aéronautiques, tout en intervenant auprès d'entreprises internationales pour promouvoir la performance, la résilience et la prise de décision rapide.

Dans une des ses vidéos de 2025 il confirme que la Terre n'est pas plate :

https://www.tiktok.com/@laterreronde.tv/video/7519092758556970262

Debunking Flat Earth Theor
www.tiktok.com/@laterreronde.tv/video/751909275855697
Un ancien pilote de chasse confirme que la Terre est bien sphérique
je vous rappelle pour les platistes que le Terre n'est pas plate
220
305
41
23
00:14 / 00:56

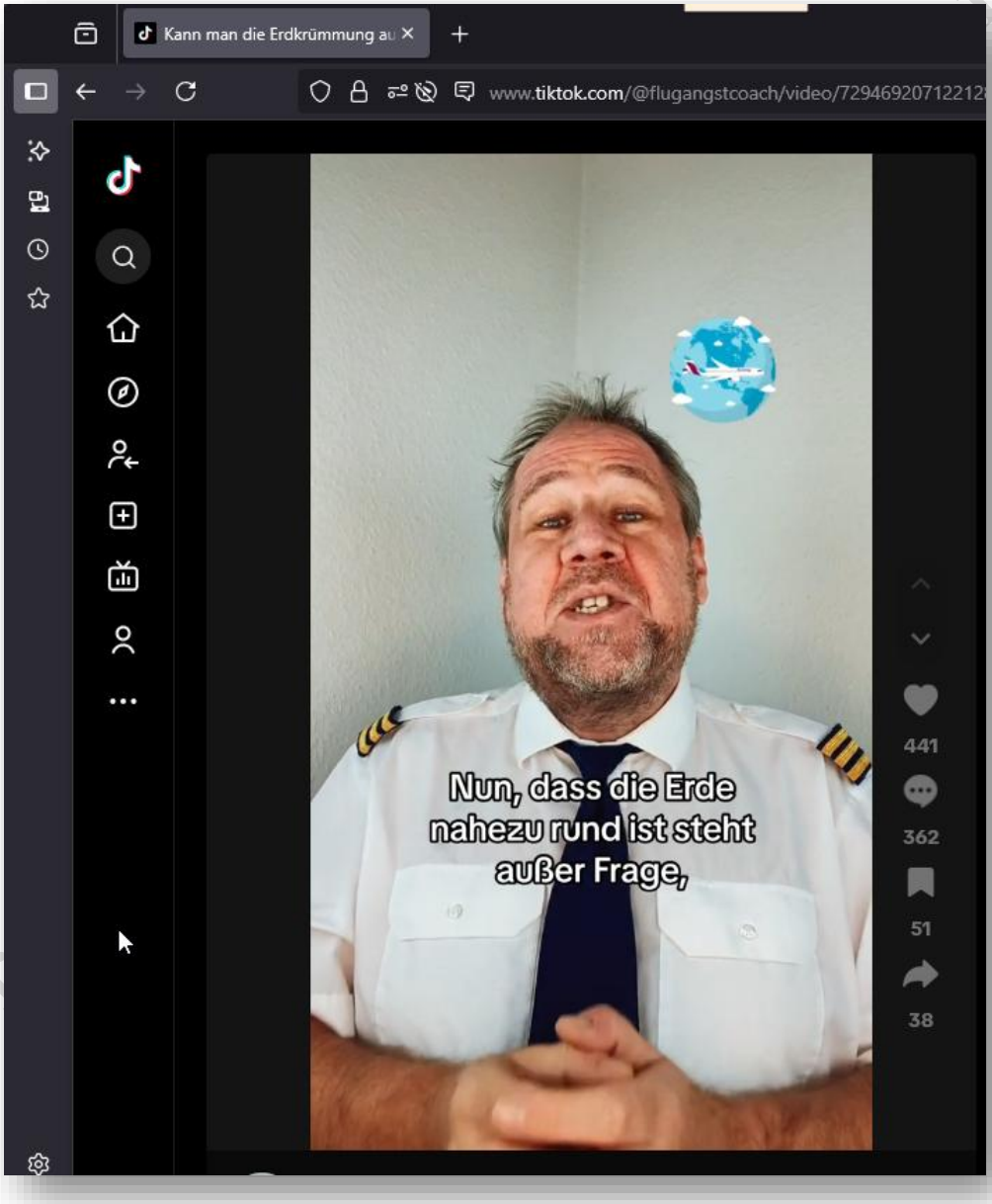
(#384) Mathias Gnida (pilote certifié, spécialiste dans la gestion de la peur de l'avion)

Mathias Gnida est un auteur allemand spécialisé dans la gestion de la peur de l'avion. Né en 1970 à Hambourg, il a commencé sa carrière comme mécanicien d'aéronefs, puis est devenu pilote certifié. Sa page LinkedIn est disponible ici :

https://www.linkedin.com/in/mathias-gnida/

Dans une vidéo TikTok il confirme que la Terre n'est pas plate :

https://vm.tiktok.com/ZNdavGsgC



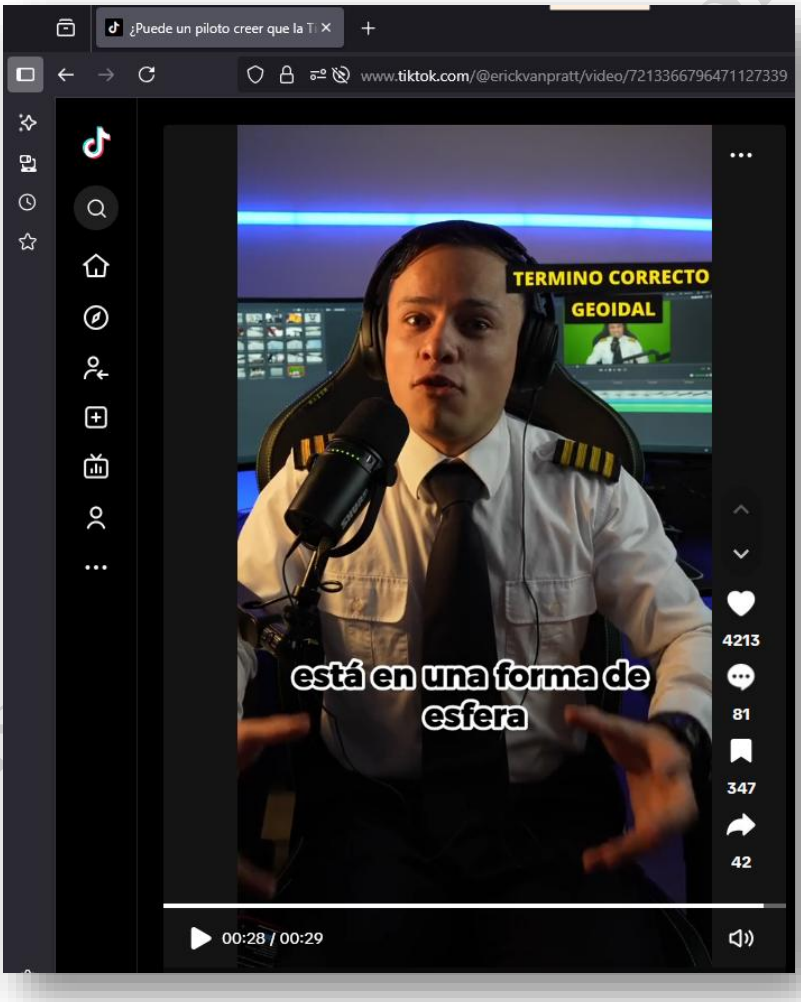
Traduit de l'allemand au français, cela donne : « La fait que la Terre soit ronde ne fait aucun doute ».

(#385) Erick Van Pratt (pilote certifié, commandant sur Airbus A320)

Erick Van Pratt est un pilote de ligne mexicain basé à Shanghai, commandant sur Airbus A320, devenu célèbre sur TikTok et YouTube grâce à ses vidéos éducatives et humoristiques sur l'aviation. Passionné depuis l'enfance, il a étudié aux États-Unis et est devenu commandant à seulement 24 ans. Il partage son quotidien de pilote, ses conseils professionnels et des anecdotes sur les coulisses du vol, tout en animant le podcast *Sin escalas*, qui aborde aussi le développement personnel.

Dans une de ses vidéos TikTok il confirme que toutes les cartes qu'ils utilisent pour la navigation sont basées sur un Terre sphérique et que c'est bien la forme de la Terre (il précise même dans un encadré que rigoureusement c'est une géoïde comme cela est visible dans la capture d'écran ci-dessous) :

https://www.tiktok.com/@erickvanpratt/video/7213366796471127339



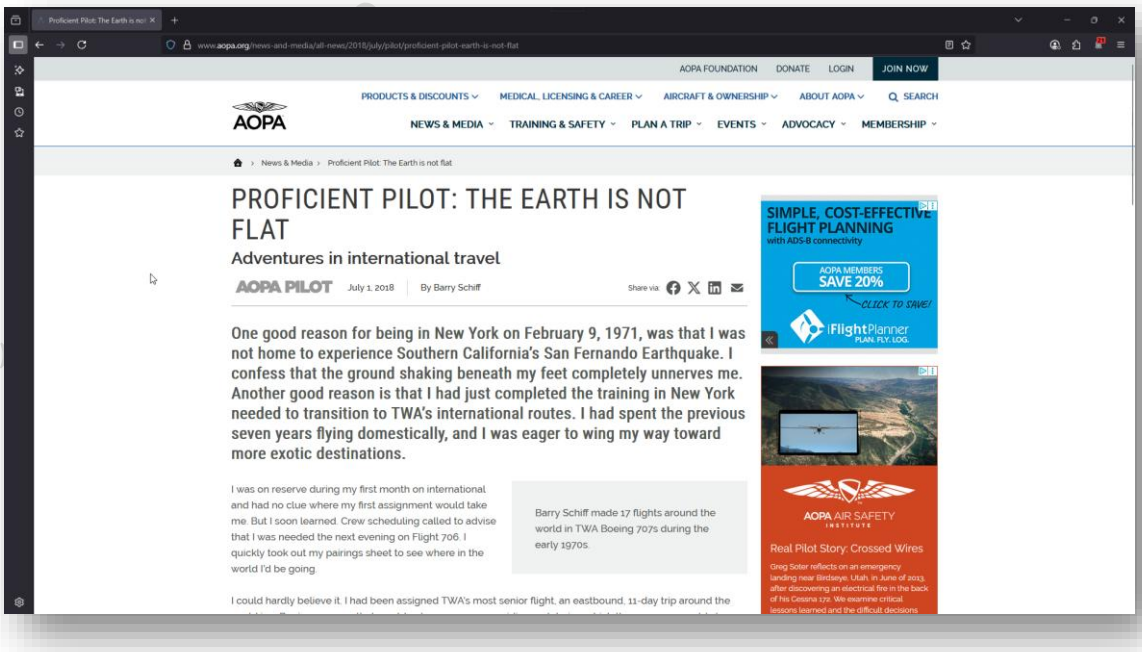
Traduit de l'espagnol au français, cela donne : « La Terre a une forme de sphère ».

(#386) Barry Schiff (ancien pilote de ligne chez TWA)

Barry Schiff est une légende de l'aviation américaine : ancien pilote de ligne chez TWA avec plus de 28 000 heures de vol sur 363 types d'aéronefs, auteur de 13 livres et de plus de 1 800 articles sur l'aviation, détenteur de records mondiaux de vitesse et pionnier du vol diplomatique entre Israël et la Jordanie. Reconnue internationalement pour son expertise, sa passion et son engagement envers la sécurité aérienne, sa carrière exemplaire lui a valu de nombreuses distinctions, dont des médailles de France, de Suisse et une commendation du Congrès américain.

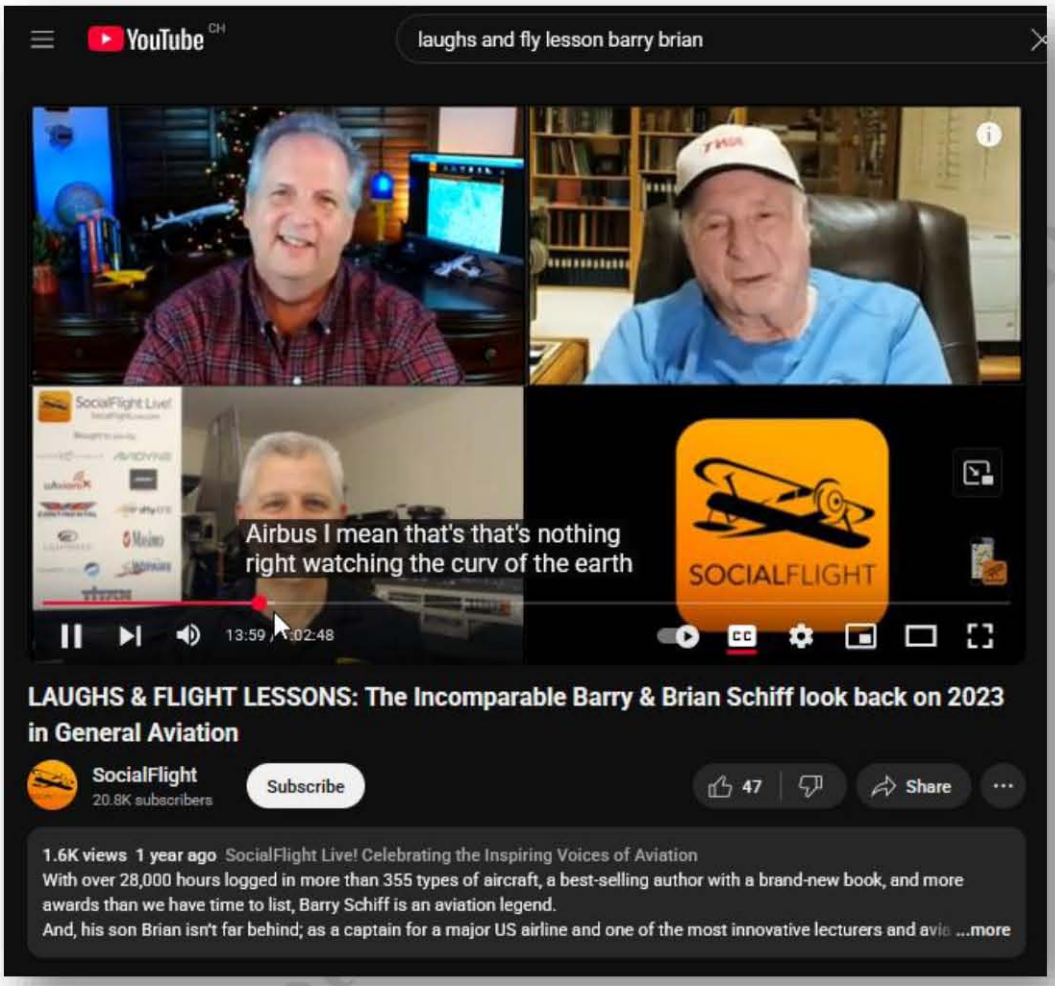
D'abord dans un article numérique qu'il a rédigé pour l'AOPA (Aircraft Owners and Pilots Association) il confirme que la Terre n'est pas plate :

https://www.aopa.org/news-and-media/all-news/2018/july/pilot/proficient-pilot-earth-is-not-flat


AOPA FOUNDATION
DONATE
LOGIN
JOIN NOW
PRODUCTS & DISCOUNTS
MEDICAL, LICENSING & CAREER
AIRCRAFT & OWNERSHIP
ABOUT AOPA
SEARCH
AOPA
NEWS & MEDIA
TRAINING & SAFETY
PLAN A TRIP
EVENTS
ADVOCACY
MEMBERSHIP
News & Media › Proficient Pilot: The Earth is not flat
PROFICIENT PILOT: THE EARTH IS NOT FLAT
Adventures in international travel
AOPA PILOT
July 1, 2018
By Barry Schiff
One good reason for being in New York on February 9, 1971, was that I was not home to experience Southern California's San Fernando Earthquake. I confess that the ground shaking beneath my feet completely unnerves me. Another good reason is that I had just completed the training in New York needed to transition to TWA's international routes. I had spent the previous seven years flying domestically, and I was eager to wing my way toward more exotic destinations.
I was on reserve during my first month on international and had no clue where my first assignment would take me. But I soon learned. Crew scheduling called to advise that I was needed the next evening on Flight 706. I quickly took out my pairings sheet to see where in the world I'd be going.
Barry Schiff made 17 flights around the world in TWA Boeing 707s during the early 1970s.
I could hardly believe it. I had been assigned TWA's most senior flight, an eastbound, 11-day trip around the
SIMPLE, COST-EFFECTIVE FLIGHT PLANNING
with ADS-B connectivity
AOPA MEMBERS SAVE 20%
CLICK TO SAVE!
iFlightPlanner
PLAN. FLY. LOG.
AOPA AIR SAFETY INSTITUTE
Real Pilot Story: Crossed Wires

Dans une vidéo YouTube spécialisée sur l'aviation il confirme la courbure de la Terre :

https://youtu.be/33zVGSMclCQ?t=802


YouTube CH
laughs and fly lesson barry brian
Airbus I mean that's that's nothing
right watching the curv of the earth
SOCIALFLIGHT
13:59 / 2:02:48
LAUGHS & FLIGHT LESSONS: The Incomparable Barry & Brian Schiff look back on 2023 in General Aviation
SocialFlight
20.8K subscribers
Subscribe
47
Share
1.6K views 1 year ago SocialFlight Live! Celebrating the Inspiring Voices of Aviation
With over 28,000 hours logged in more than 355 types of aircraft, a best-selling author with a brand-new book, and more awards than we have time to list, Barry Schiff is an aviation legend.
And, his son Brian isn't far behind; as a captain for a major US airline and one of the most innovative lecturers and avia ...more

translation

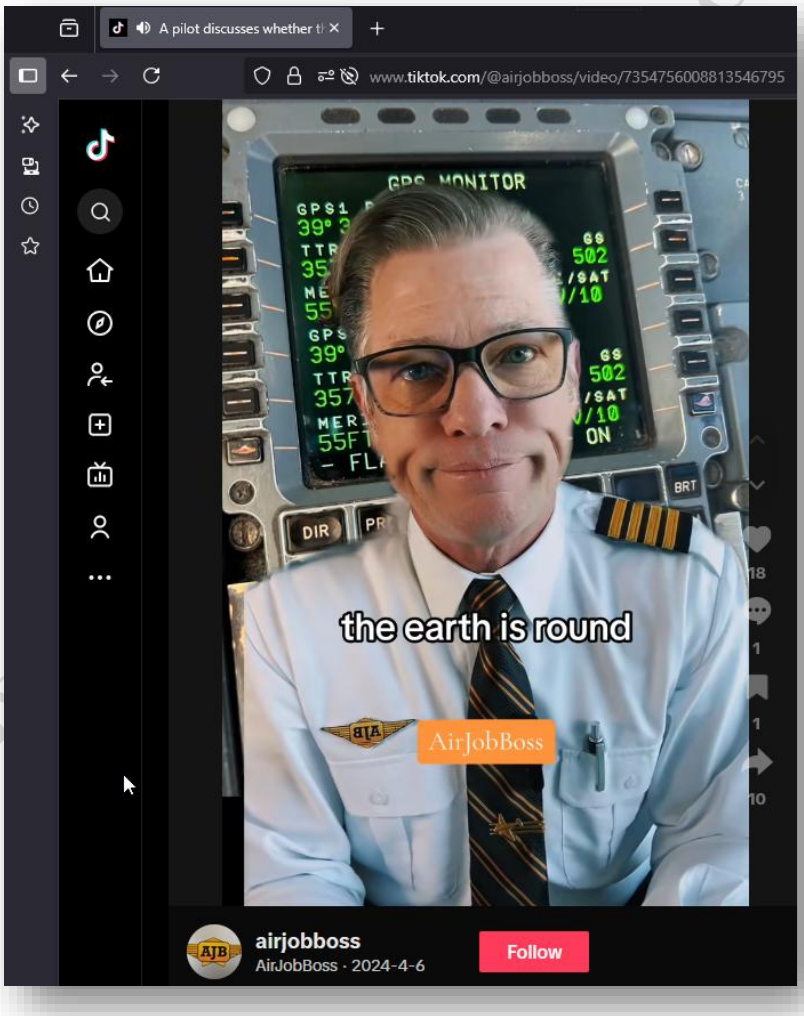
(#387) Blain Dapper (capitaine chez American-Airlines sur Boeing 738)

Blain Dapper est un pilote chevronné avec plus de 36 ans d'expérience dans l'aviation, actuellement commandant de bord chez American Airlines. Il est également le fondateur d'*AirJobBoss*, une plateforme de mentorat et de développement de carrière qui aide les aspirants pilotes à réussir leurs entretiens et à mieux comprendre l'industrie aérienne. Reconnu pour ses talents de communicateur et son implication dans la formation, il a occupé des postes de direction au Japon, notamment chez Skymark Airlines. Son parcours témoigne d'un engagement profond à transmettre ses connaissances et à inspirer la nouvelle génération de professionnels de l'aviation. Sa page LinkedIn est disponible ici :

https://www.linkedin.com/in/blain-dapper-a5400717/

Dans une vidéo TikTok il confirme que la Terre n'est pas plate :

https://www.tiktok.com/@airjobboss/video/7354756008813546795



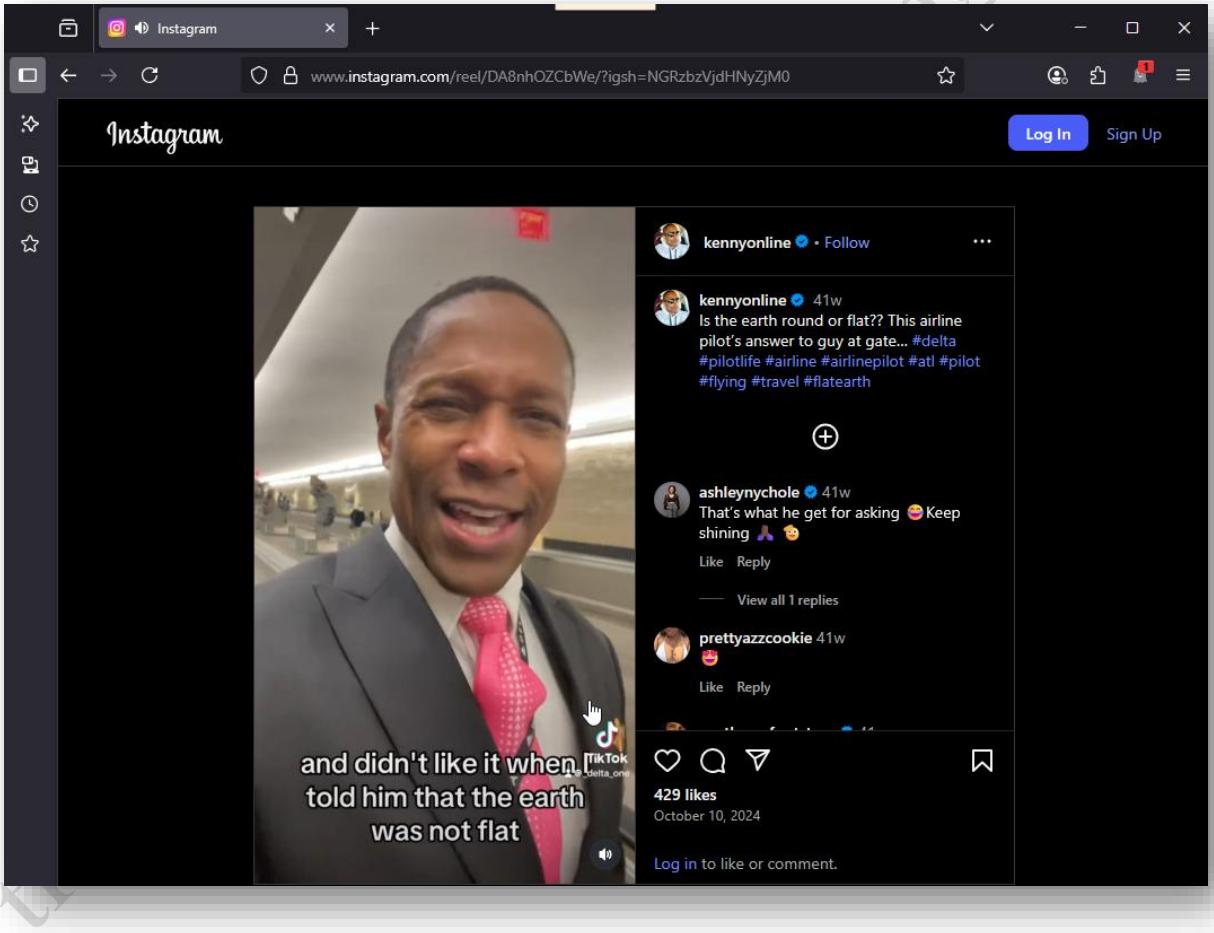
(#388) Kenneth Card (pilote de ligne chez Delta Air Lines, ancien pilote de l'US Air)

Kenneth Card est un pilote de ligne chez Delta Air Lines, ancien pilote de l'US Air Force sur l'AC-130U Spooky Gunship, et créateur de contenu sur YouTube. Il partage régulièrement des vidéos sur sa vie de pilote, ses vols à bord d'Airbus A320 et A321, ainsi que des conseils et anecdotes liés à l'aviation commerciale et militaire. Son parcours reflète une passion pour le vol, la transmission de savoir, et l'inspiration des futurs aviateurs à travers ses réseaux sociaux. Sa page LinkedIn est disponible ici :

https://www.linkedin.com/in/kennyonline/

Dans une vidéo Instagram il confirme que la Terre n'est pas plate :

https://www.instagram.com/reel/DA8nhOZCbWe/

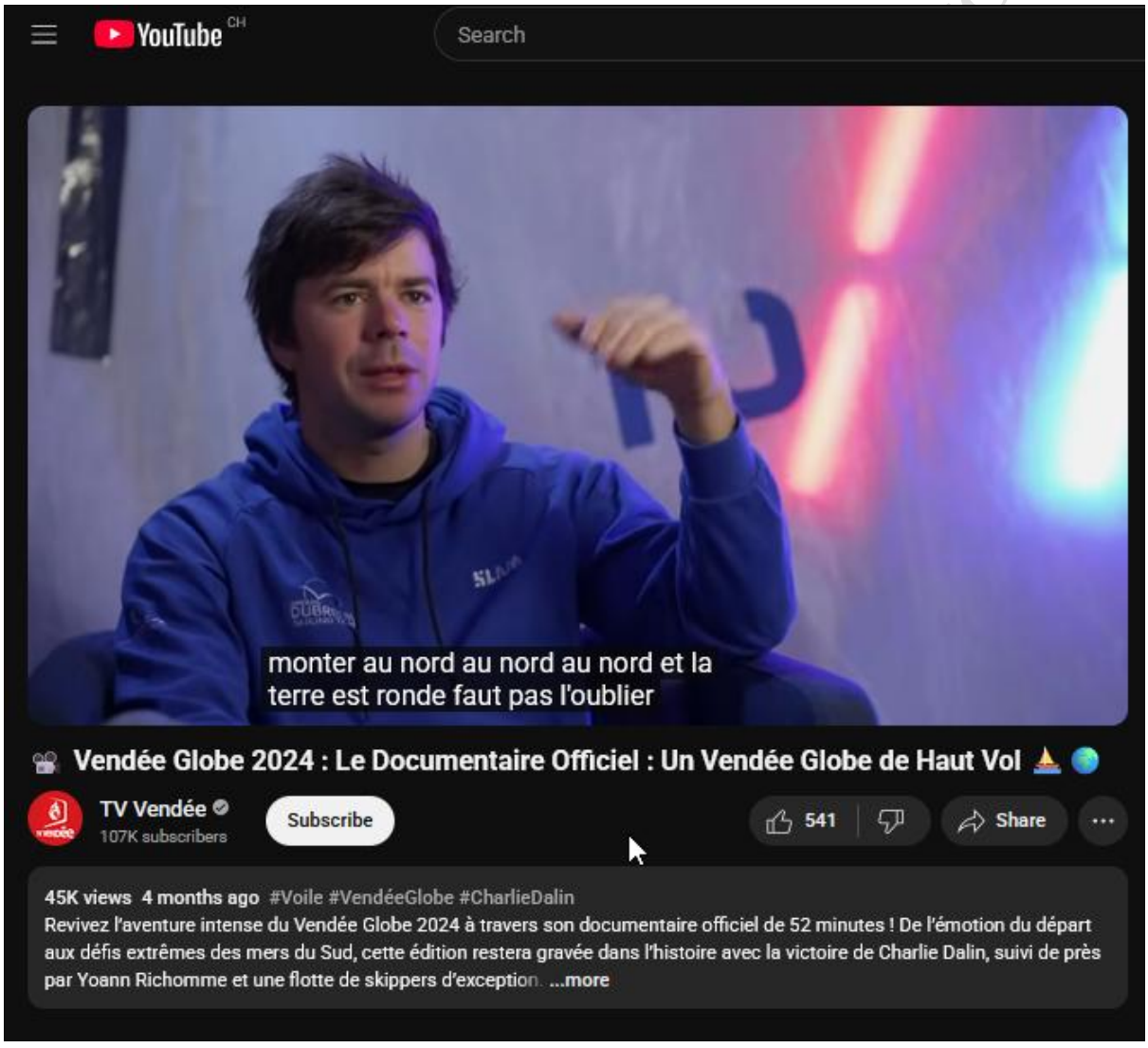

Instagram
www.instagram.com/reel/DA8nhOZCbWe/?igsh=NGRzbzVjdHNyZjM0
Instagram
Log In
Sign Up
kennyonline • Follow
kennyonline 41w
Is the earth round or flat?? This airline pilot's answer to guy at gate... #delta #pilotlife #airline #airlinepilot #atl #pilot #flying #travel #flatearth
ashleynychole 41w
That's what he get for asking Keep shining
Like Reply
View all 1 replies
prettyazzcookie 41w
Like Reply
and didn't like it when I told him that the earth was not flat
TikTok
429 likes
October 10, 2024
Log in to like or comment.

(#389) Sébastien Simon (skipper français, ingénieur strucvtures)

Sébastien Simon est un skipper français né en 1990 à La Roche-sur-Yon, ingénieur en structures et composites, passionné de voile depuis l'enfance. Après avoir brillé en dériveur (3e au championnat du monde 420 en 2013), il s'est imposé sur le circuit Figaro, remportant la Solitaire du Figaro en 2018 et le titre de champion de France de course au large. Il a participé au Vendée Globe 2020, contraint à l'abandon après une collision, puis a rebondi en 2024 avec le Groupe Dubreuil, terminant 3e de la course en battant le record de distance parcourue en 24h. Il est le premier Sablais à monter sur le podium de cette mythique course autour du monde.

Dans un interview il confirme que la Terre est ronde :

https://youtu.be/YKzm4LvgqTY?t=1586

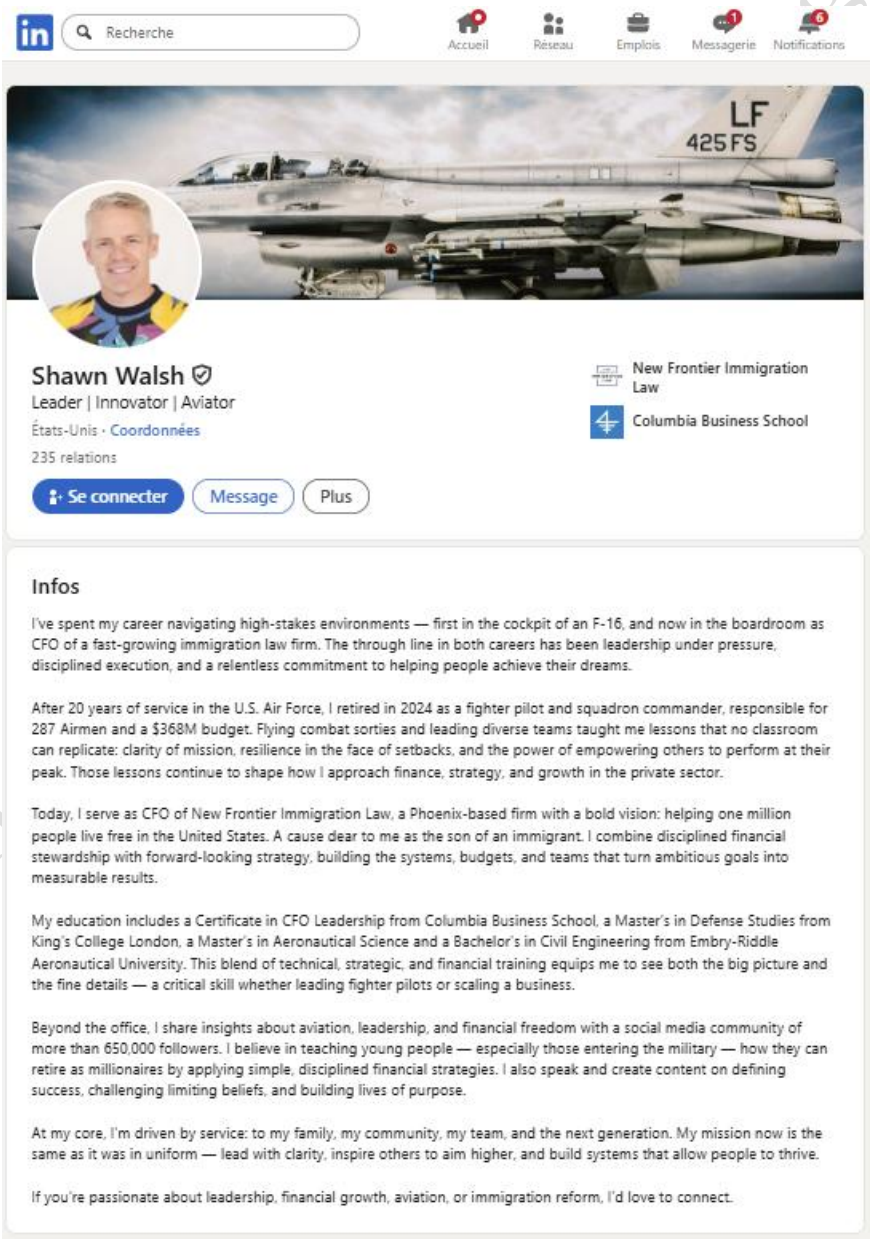

YouTube CH
Search
monter au nord au nord au nord et la
terre est ronde faut pas l'oublier
Vendée Globe 2024 : Le Documentaire Officiel : Un Vendée Globe de Haut Vol
TV Vendée
107K subscribers
Subscribe
541
Share
45K views 4 months ago #Voile #VendéeGlobe #CharlieDalin
Revivez l'aventure intense du Vendée Globe 2024 à travers son documentaire officiel de 52 minutes ! De l'émotion du départ aux défis extrêmes des mers du Sud, cette édition restera gravée dans l'histoire avec la victoire de Charlie Dalin, suivi de près par Yoann Richomme et une flotte de skippers d'exception. ...more

(#390) Shawn Walsh (ancien pilote de F-16)

Shawn Walsh est un ancien pilote de chasse F-16 de l'US Air Force, où il a servi plus de vingt ans avant de prendre sa retraite en 2024 comme commandant d'escadron, responsable de 287 aviateurs et d'un budget de 368 millions de dollars . Après sa carrière militaire, il s'est reconverti dans le secteur civil comme dirigeant d'entreprise tout en devenant un créateur de contenu très suivi : sa chaîne YouTube compte plus de 120 000 abonnés et propose des vidéos pédagogiques sur l'aviation militaire, la vie de pilote de chasse, la prise de décision sous pression et la reconversion professionnelle . Il est également actif sur TikTok, où il partage des conseils sur la carrière militaire, la finance personnelle et les coulisses du métier de pilote.

Voici le lien vers son profil LinkedIn :

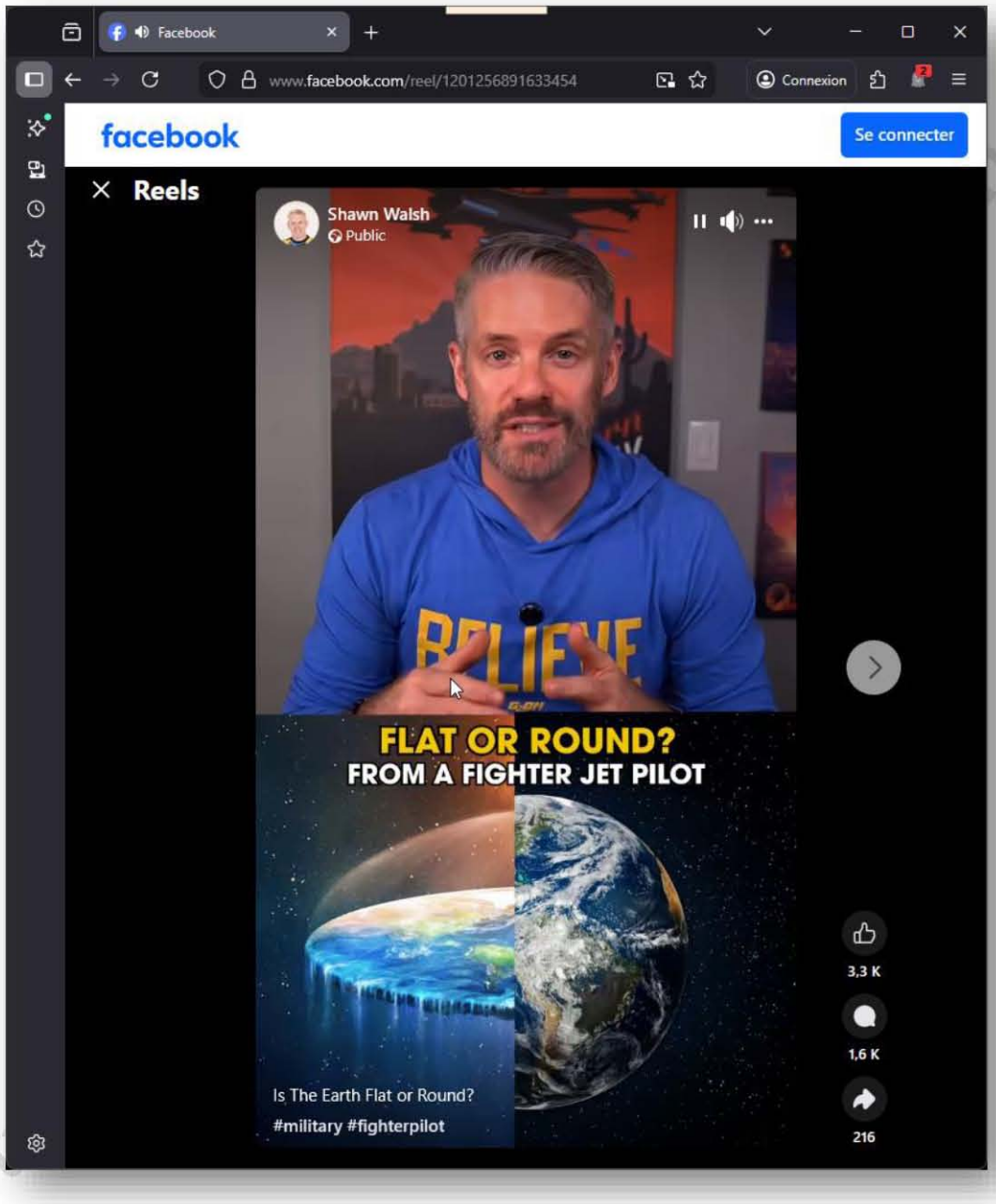
https://www.linkedin.com/in/realshawnwalsh/


Recherche
Accueil
Réseau
Emplois
Messagerie
Notifications
LF
425 FS
Shawn Walsh
Leader | Innovator | Aviator
États-Unis · Coordonnées
235 relations
Se connecter
Message
Plus
New Frontier Immigration Law
Columbia Business School
Infos
I've spent my career navigating high-stakes environments — first in the cockpit of an F-16, and now in the boardroom as CFO of a fast-growing immigration law firm. The through line in both careers has been leadership under pressure, disciplined execution, and a relentless commitment to helping people achieve their dreams.
After 20 years of service in the U.S. Air Force, I retired in 2024 as a fighter pilot and squadron commander, responsible for 287 Airmen and a $368M budget. Flying combat sorties and leading diverse teams taught me lessons that no classroom can replicate: clarity of mission, resilience in the face of setbacks, and the power of empowering others to perform at their peak. Those lessons continue to shape how I approach finance, strategy, and growth in the private sector.
Today, I serve as CFO of New Frontier Immigration Law, a Phoenix-based firm with a bold vision: helping one million people live free in the United States. A cause dear to me as the son of an immigrant. I combine disciplined financial stewardship with forward-looking strategy, building the systems, budgets, and teams that turn ambitious goals into measurable results.
My education includes a Certificate in CFO Leadership from Columbia Business School, a Master's in Defense Studies from King's College London, a Master's in Aeronautical Science and a Bachelor's in Civil Engineering from Embry-Riddle Aeronautical University. This blend of technical, strategic, and financial training equips me to see both the big picture and the fine details — a critical skill whether leading fighter pilots or scaling a business.
Beyond the office, I share insights about aviation, leadership, and financial freedom with a social media community of more than 650,000 followers. I believe in teaching young people — especially those entering the military — how they can retire as millionaires by applying simple, disciplined financial strategies. I also speak and create content on defining success, challenging limiting beliefs, and building lives of purpose.
At my core, I'm driven by service: to my family, my community, my team, and the next generation. My mission now is the same as it was in uniform — lead with clarity, inspire others to aim higher, and build systems that allow people to thrive.
If you're passionate about leadership, financial growth, aviation, or immigration reform, I'd love to connect.

Dans sa vidéo disponible ici :

https://www.facebook.com/reel/1201256891633454

Il confirme que la Terre est un globe et que la courbure est bien visible :

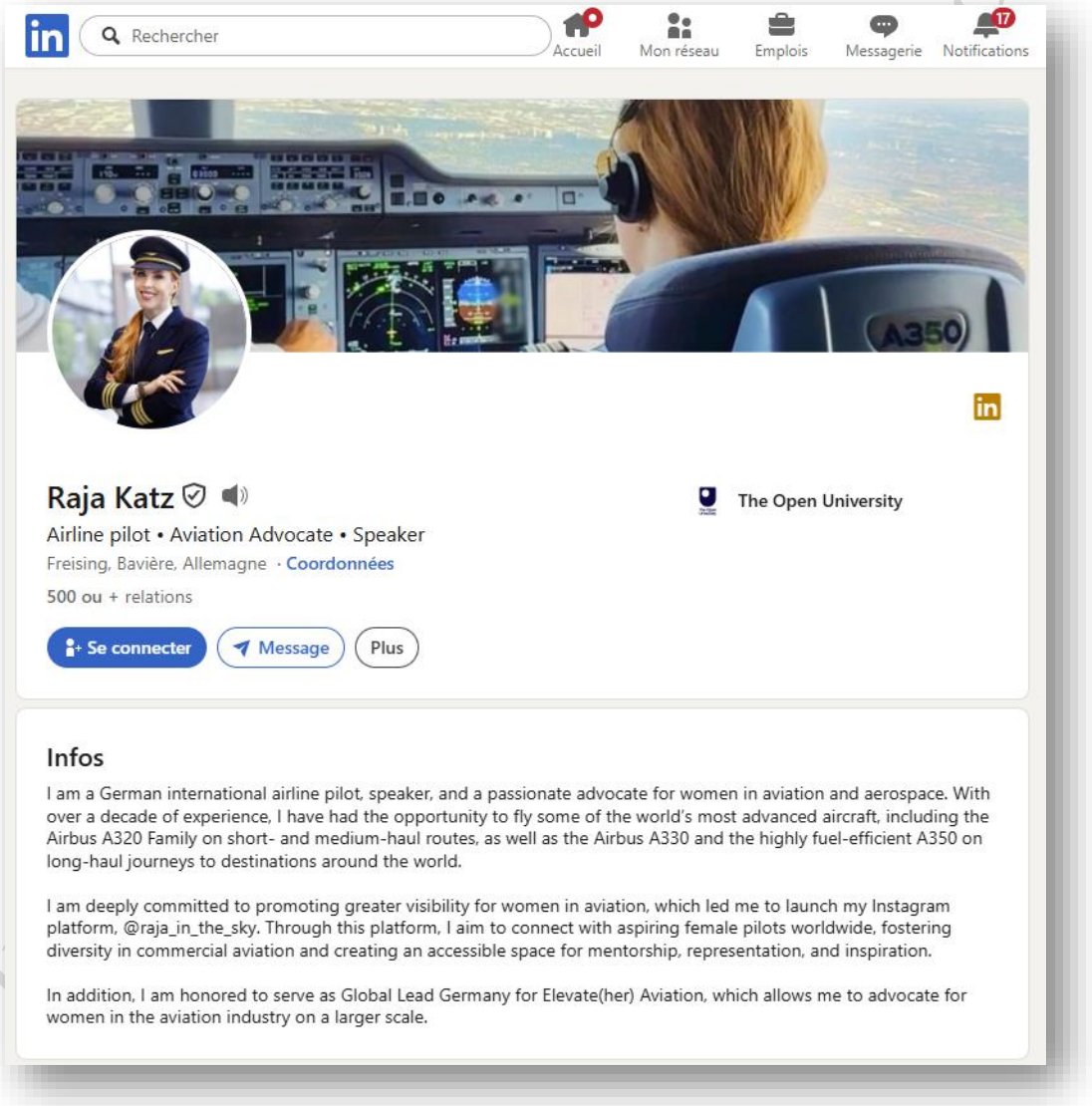


(#391) Raja Katz (pilote de ligne sur Airbus)

Raja Katz est une pilote de ligne allemande, active depuis plus de douze ans sur les Airbus A320, A330 et A350, dans l'aviation passagers et cargo. Elle est aussi conférencière, créatrice de contenu et responsable Allemagne d'Elevate (her) Aviation, une organisation qui promeut la représentation des femmes dans les métiers aéronautiques. Passionnée depuis l'adolescence, elle partage sur ses réseaux des témoignages de cockpit pour inspirer les futures pilotes et rendre l'industrie plus inclusive.

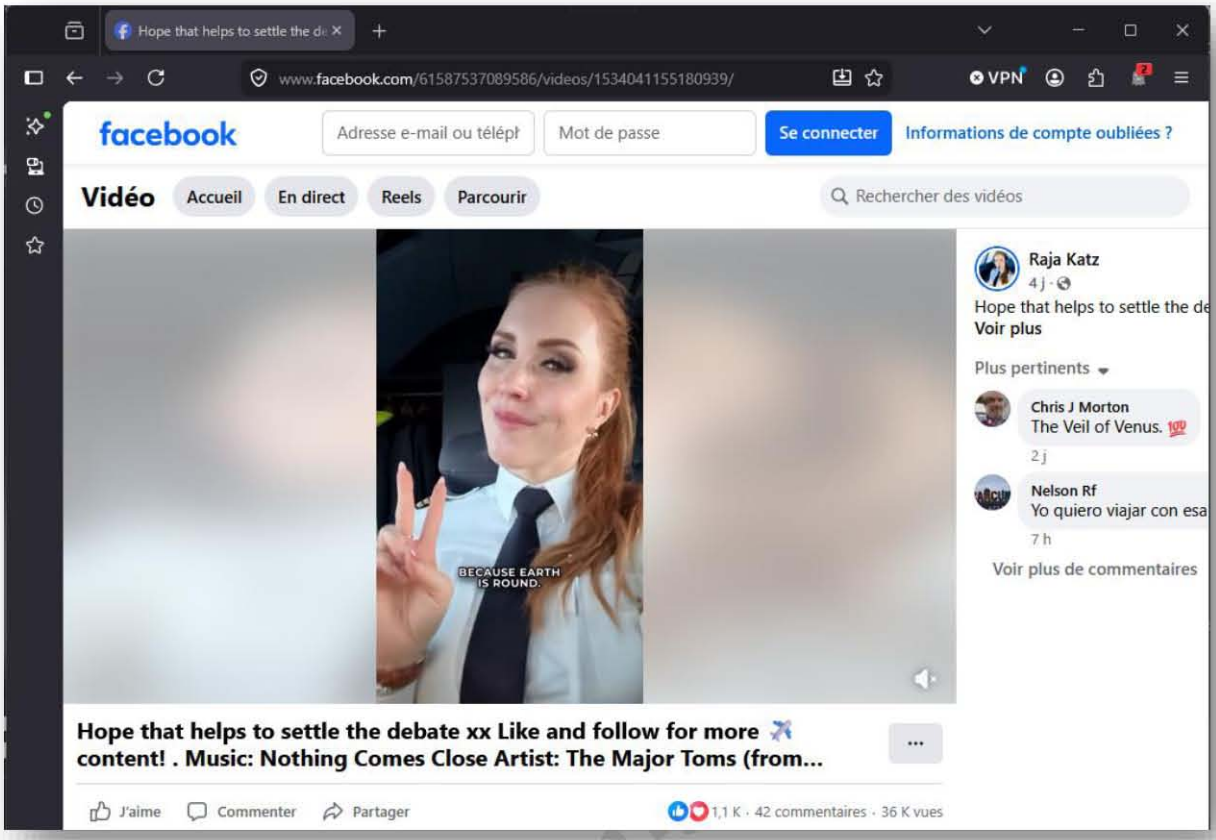
Voici son LinkedIn :

https://www.linkedin.com/in/raja-katz-983923342/


Rechercher
Accueil
Mon réseau
Emplois
Messagerie
Notifications
17
A350
Raja Katz
Airline pilot • Aviation Advocate • Speaker
Freising, Bavière, Allemagne · Coordonnées
500 ou + relations
The Open University
Se connecter
Message
Plus
Infos
I am a German international airline pilot, speaker, and a passionate advocate for women in aviation and aerospace. With over a decade of experience, I have had the opportunity to fly some of the world's most advanced aircraft, including the Airbus A320 Family on short- and medium-haul routes, as well as the Airbus A330 and the highly fuel-efficient A350 on long-haul journeys to destinations around the world.
I am deeply committed to promoting greater visibility for women in aviation, which led me to launch my Instagram platform, @raja_in_the_sky. Through this platform, I aim to connect with aspiring female pilots worldwide, fostering diversity in commercial aviation and creating an accessible space for mentorship, representation, and inspiration.
In addition, I am honored to serve as Global Lead Germany for Elevate(her) Aviation, which allows me to advocate for women in the aviation industry on a larger scale.

La vidéo où elle confirme que la Terre est ronde est disponible ici sur son compte Faceboo :

https ://www.facebook.com/watch/ ?ref=saved&v=1534041155180939



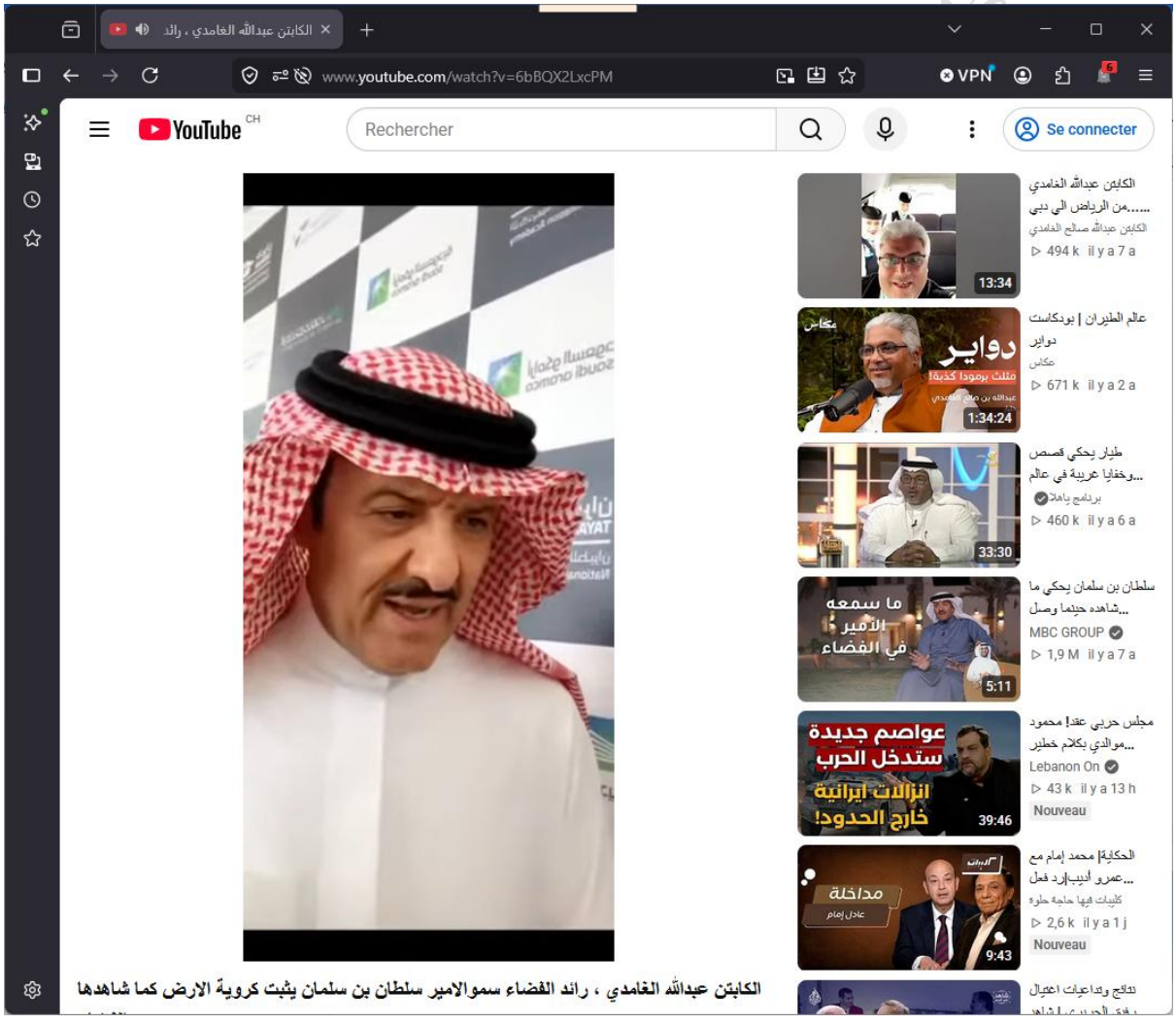
translation into en

(#392) Sultan ben Salmane (premier musulman à avoir été dans l'espace)

Le Sultan ben Salmane Al Saoud est un prince saoudien né en 1956, fils du roi Salmane, connu surtout pour avoir été le premier Arabe, premier musulman (sunnite) et premier membre d'une famille royale à voyager dans l'espace : il a volé comme spécialiste de charge utile à bord de la navette Discovery (mission STS-51-G) en juin 1985, représentant l'organisation ARABSAT et participant au déploiement du satellite Arabsat-1B. Après sa carrière de pilote de chasse dans l'armée de l'air saoudienne, il a occupé plusieurs postes de haut niveau, notamment président de la Saudi Space Commission et conseiller du roi, tout en restant une figure majeure du développement spatial et aéronautique du royaume.

Dans la vidéo disponible ici :

https://www.youtube.com/watch?v=6bBQX2LxcPM



Voici le transcript de la discussion :

- [00:00] - Capitaine Abdullah Al-Ghamdi :

« Nous sommes maintenant en présence de Son Altesse Royale le Prince Sultan ben Salmane. Bonjour Abu Salmane. Que Dieu vous donne longue vie. »

- [00:08] - Capitaine Abdullah Al-Ghamdi :

  « Abu Salmane, il y a une question que se posent des millions de personnes. En tant que premier spationaute arabe et musulman, comment avez-vous vu la Terre depuis l'espace ? »

- [00:22] - Prince Sultan ben Salmane :

  « Je suis très heureux de vous voir ainsi que vos abonnés. J'en ai déjà parlé dans des documentaires et sur le site dédié à ma mission spatiale (qui a duré 7 jours). J'y raconte beaucoup d'histoires. Mais en résumé : j'ai vu la Terre plus petite que ce qu'on imagine. De cette distance, on réalise que tous les êtres humains ne forment qu'un, et que les frontières entre les pays ne sont que des limites administratives et organisationnelles, pas des barrières qui divisent les hommes. Et j'ai vu notre pays comme le plus beau pays. »

- [00:52] - Capitaine Abdullah Al-Ghamdi :

  « L'avez-vous vue sphérique ou plate, Votre Altesse ? »

- [00:54] - Prince Sultan ben Salmane :

  « Elle est évidemment sphérique ! Nous faisions le tour complet de la Terre toutes les 90 minutes. »

- [01:05] - Prince Sultan ben Salmane :

  « Chaque jour, nous assistions à 16 levers et 16 couchers de soleil. D'ailleurs, pour faire nos prières, le temps que l'on commence la prière au-dessus d'une région comme l'Afrique, le temps de réciter et de s'incliner, nous étions déjà arrivés au-dessus de La Mecque ! Notre vitesse était de près de 28 000 km/h. »

- [01:25] - Capitaine Abdullah Al-Ghamdi :

  « Donc l'avez-vous vue sphérique ou plate ? Quelle est la réponse définitive, Votre Altesse ? »

- [01:27] - Prince Sultan ben Salmane :

  « Comme je vous l'ai dit, nous tournions autour du globe terrestre. Personne ne peut prétendre qu'elle est plate. Si quelqu'un prétend qu'elle est plate, ce serait inventer une histoire absurde. Les faits scientifiques et les photos le prouvent. »

- [01:40] - Capitaine Abdullah Al-Ghamdi :

  « Merci beaucoup, Votre Altesse. Que Dieu vous accorde une longue vie, Abu Salmane. Transmettez nos salutations à votre père »

translation into english ongoing

translation into english ongoing

(#393) Absence de preuves de la Terre plate

Probablement une des meilleures preuves que la Terre n'est pas globalement plate est de prendre en considération les éléments suivants :

- La plus ancienne preuve archéologique que la Terre est considérée comme une sphère date seulement du 5e siècle avant notre ère soit environ 2'600 ans !

- Le paradigme de la Terre plate, existant encore aujourd'hui pour rappel, est beaucoup plus vieux que celui de la Terre sphérique comme l'attestent les livres « saints » de l'hindouisme, du judaïsme, de l'islam où il est clair que la Terre est décrite comme une Terre plate (puisque ces dogmes datent d'environ 2000 à 3000 ans avant les premiers écrits archéologiques mentionnant une Terre sphérique) !

- Donc le paradigme de la Terre plate existe au minimum depuis beaucoup plus longtemps que la Terre sphérique (donc depuis que les hominidés existent) !

- Il existe de part le monde des universités religieuses (juives, catholiques, évangéliques, islamistes) qui ont des budgets de plusieurs dizaines de millions de dollars et plus par année et qui font de la recherche scientifique sur les « miracles » et écrits de leurs textes saints.

- Aucun chercheur/scientifique de ces universités (depuis que la première université existe, c'est-à-dire environ 1'000 ans) n'a été capable de prouver scientifiquement que la Terre est globalement plate comme affirmé et décrit par leurs textes religieux.

  Il faut savoir par exemple qu'il existe plusieurs universités créationnistes aux États-Unis comme nommée la « Liberty University » qui a un budget de 551 millions de dollars par an et dont le budget dédié à la recherche scientifique comme indiqué dans sa comptabilité (disponible sur Internet) varie d'entre 650'000 et 1.489 millions de dollars par an. Et même avec autant d'argent… toujours aucune preuve que la Terre est plate !

  Il existe aussi des universités créationnistes islamiques comme la Darussalam Gontor University en Indonésie, sponsorisée par l'Arabie Saoudite. Malheureusement ils se gardent bien de communiquer leur budget annuel et celui dédié à la recherche scientifique. Toutefois nous pouvons observer qu'ils ont aussi aucune preuve que la Terre est plate !

- Il n'existe aussi aucun article scientifique publié dans une revue à comité de lecture en double ou triple aveugle avec un impact factor supérieur à 20 (et donc avec un numéro D.O.I. associé) qui a été capable de prouver empiriquement que la Terre est globalement plate[15].

translation into english ongoing

[15] Il y en au moins 30 000 en 2024 qui prouvent par contre que la Terre est une sphère oblate !

Cette absence de preuves d'une hypothèse – celle que la Terre est globalement plate - tellement facilement vérifiable pour des universités qui ont des millions de dollars de budgets avec les technologies disponibles depuis au moins 400 ans est plus que suspect !

Il s'agit évidemment d'une preuve au-delà de tout doute raisonnable que la Terre n'est pas globalement plate !

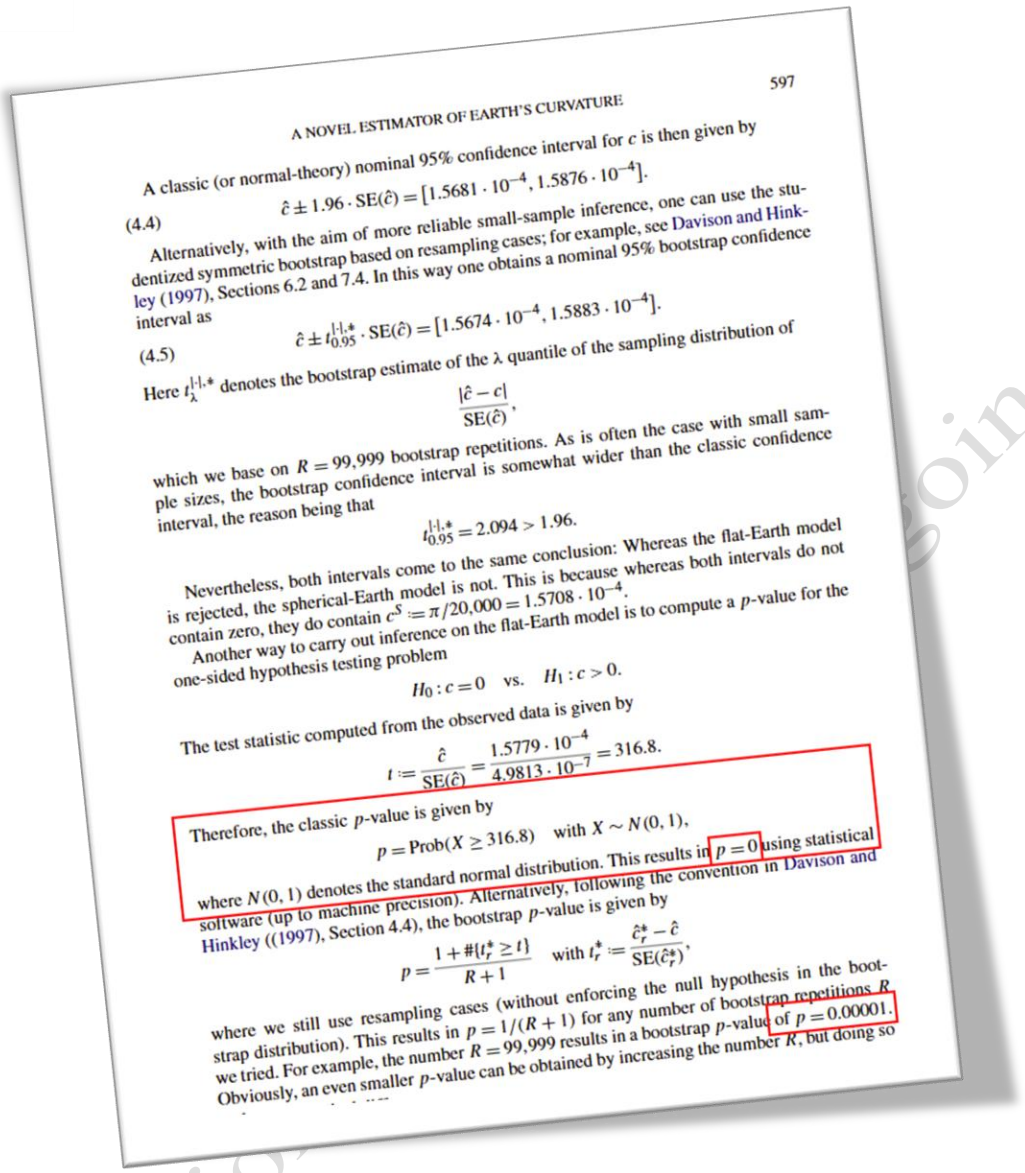
Preuves NHST de la courbure du globe

Les partisans de la Terre plate n'ont aucune preuve scientifique (donc basée évidemment sur la NHST[16] et la *p*-valeur associé que toutes les expériences en physique utilisent depuis plus d'un siècle) que la Terre est plate comme ils l'affirment.

Alors que pour le globe il existe des preuves via NHST que la Terre est un globe comme par exemple (A novel estimator of Earth's curvature (allowing for inference as well), 2024), DOI: 10.1214/23-AOAS1802 :

translation into english ongoing

[16] NHST est l'acronyme de Null Hypothesis Statistical Test. Pour la technique des NHST voir (Opera Magistris, 2024).



A NOVEL ESTIMATOR OF EARTH'S CURVATURE 597

A classic (or normal-theory) nominal 95% confidence interval for c is then given by

$$\hat{c} \pm 1.96 \cdot \mathrm{SE}(\hat{c}) = [1.5681 \cdot 10^{-4}, 1.5876 \cdot 10^{-4}]. \quad (4.4)$$

Alternatively, with the aim of more reliable small-sample inference, one can use the studentized symmetric bootstrap based on resampling cases; for example, see Davison and Hinkley (1997), Sections 6.2 and 7.4. In this way one obtains a nominal 95% bootstrap confidence interval as

$$\hat{c} \pm t^{|\cdot|,*}_{0.95} \cdot \mathrm{SE}(\hat{c}) = [1.5674 \cdot 10^{-4}, 1.5883 \cdot 10^{-4}]. \quad (4.5)$$

Here $t^{|\cdot|,*}_{\lambda}$ denotes the bootstrap estimate of the λ quantile of the sampling distribution of

$$\frac{|\hat{c} - c|}{\mathrm{SE}(\hat{c})},$$

which we base on $R = 99{,}999$ bootstrap repetitions. As is often the case with small sample sizes, the bootstrap confidence interval is somewhat wider than the classic confidence interval, the reason being that

$$t^{|\cdot|,*}_{0.95} = 2.094 > 1.96.$$

Nevertheless, both intervals come to the same conclusion: Whereas the flat-Earth model is rejected, the spherical-Earth model is not. This is because whereas both intervals do not contain zero, they do contain $c^S := \pi/20{,}000 = 1.5708 \cdot 10^{-4}$.

Another way to carry out inference on the flat-Earth model is to compute a p-value for the one-sided hypothesis testing problem

$$H_0 : c = 0 \quad \text{vs.} \quad H_1 : c > 0.$$

The test statistic computed from the observed data is given by

$$t := \frac{\hat{c}}{\mathrm{SE}(\hat{c})} = \frac{1.5779 \cdot 10^{-4}}{4.9813 \cdot 10^{-7}} = 316.8.$$

Therefore, the classic p-value is given by

$$p = \mathrm{Prob}(X \geq 316.8) \quad \text{with } X \sim N(0,1),$$

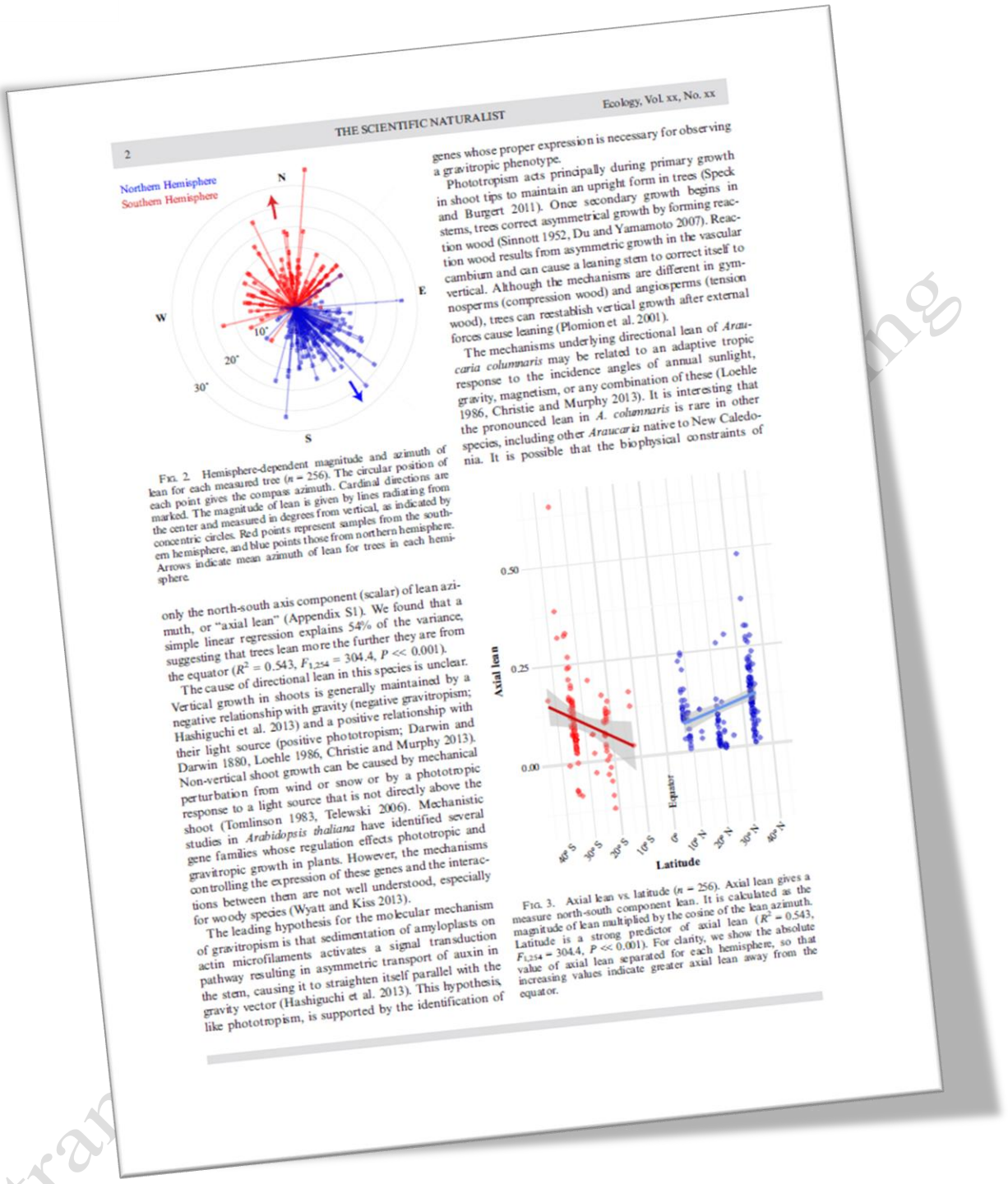
where $N(0,1)$ denotes the standard normal distribution. This results in $p = 0$ using statistical software (up to machine precision). Alternatively, following the convention in Davison and Hinkley ((1997), Section 4.4), the bootstrap p-value is given by

$$p = \frac{1 + \#\{t^*_r \geq t\}}{R+1} \quad \text{with } t^*_r := \frac{\hat{c}^*_r - \hat{c}}{\mathrm{SE}(\hat{c}^*_r)},$$

where we still use resampling cases (without enforcing the null hypothesis in the bootstrap distribution). This results in $p = 1/(R+1)$ for any number of bootstrap repetitions R we tried. For example, the number $R = 99{,}999$ results in a bootstrap p-value of $p = 0.00001$. Obviously, an even smaller p-value can be obtained by increasing the number R, but doing so

Donc avec du bootstrap (méthode de rééchantillonnage statistique) nous avons un p-valeur de 0.001 % soit environ 4.5σ.

Et nous avons vu aussi une autre la p-valeur de 0.001 d'un phénomène sujet (Worldwide hemisphere-dependent lean in Cook pines, 2017), DOI 10.1002/ecy.1850, lié aussi à la forme de la Terre pour rappel (voir page **Erreur ! Signet non défini.**) :



2 THE SCIENTIFIC NATURALIST Ecology, Vol. xx, No. xx

Northern Hemisphere
Southern Hemisphere
N
E
S
W
10°
20°
30°

FIG. 2. Hemisphere-dependent magnitude and azimuth of lean for each measured tree ($n = 256$). The circular position of each point gives the compass azimuth. Cardinal directions are marked. The magnitude of lean is given by lines radiating from the center and measured in degrees from vertical, as indicated by concentric circles. Red points represent samples from the southern hemisphere, and blue points those from northern hemisphere. Arrows indicate mean azimuth of lean for trees in each hemisphere.

only the north-south axis component (scalar) of lean azimuth, or "axial lean" (Appendix S1). We found that a simple linear regression explains 54% of the variance, suggesting that trees lean more the further they are from the equator ($R^2 = 0.543$, $F_{1,254} = 304.4$, $P << 0.001$).

The cause of directional lean in this species is unclear. Vertical growth in shoots is generally maintained by a negative relationship with gravity (negative gravitropism; Hashiguchi et al. 2013) and a positive relationship with their light source (positive phototropism; Darwin and Darwin 1880, Loehle 1986, Christie and Murphy 2013). Non-vertical shoot growth can be caused by mechanical perturbation from wind or snow or by a phototropic response to a light source that is not directly above the shoot (Tomlinson 1983, Telewski 2006). Mechanistic studies in *Arabidopsis thaliana* have identified several gene families whose regulation effects phototropic and gravitropic growth in plants. However, the mechanisms controlling the expression of these genes and the interactions between them are not well understood, especially for woody species (Wyatt and Kiss 2013).

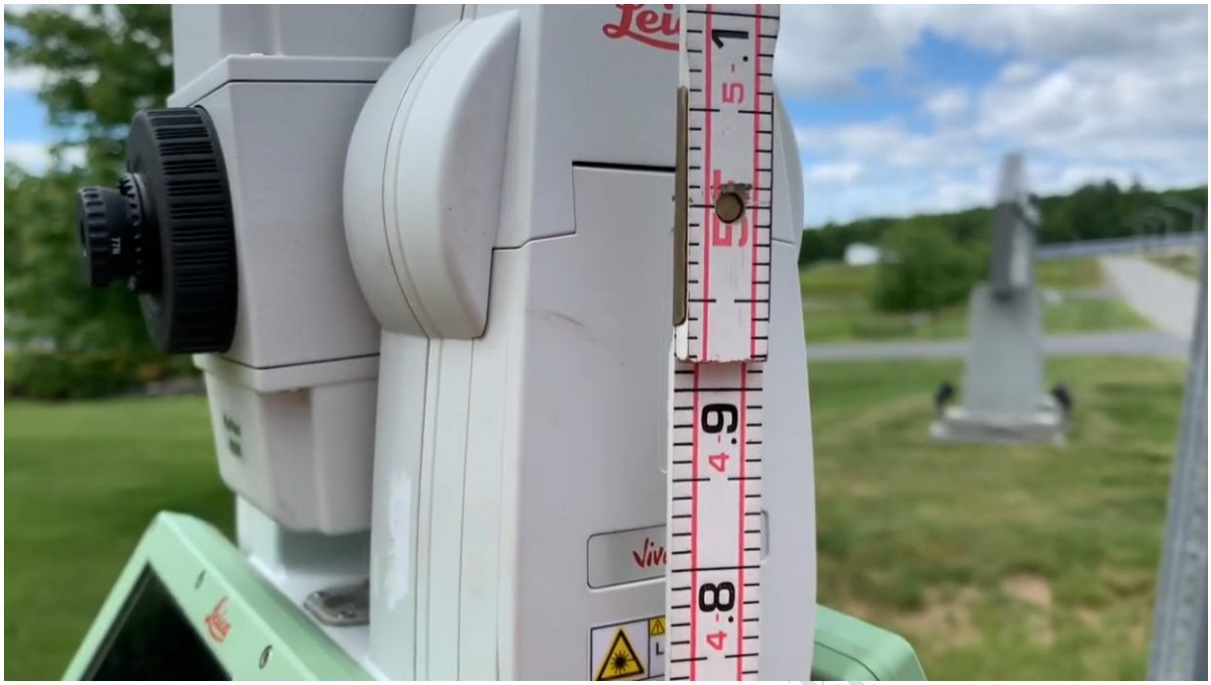
The leading hypothesis for the molecular mechanism of gravitropism is that sedimentation of amyloplasts on actin microfilaments activates a signal transduction pathway resulting in asymmetric transport of auxin in the stem, causing it to straighten itself parallel with the gravity vector (Hashiguchi et al. 2013). This hypothesis, like phototropism, is supported by the identification of genes whose proper expression is necessary for observing a gravitropic phenotype.

Phototropism acts principally during primary growth in shoot tips to maintain an upright form in trees (Speck and Burgert 2011). Once secondary growth begins in stems, trees correct asymmetrical growth by forming reaction wood (Sinnott 1952, Du and Yamamoto 2007). Reaction wood results from asymmetric growth in the vascular cambium and can cause a leaning stem to correct itself to vertical. Although the mechanisms are different in gymnosperms (compression wood) and angiosperms (tension wood), trees can reestablish vertical growth after external forces cause leaning (Plomion et al. 2001).

The mechanisms underlying directional lean of *Araucaria columnaris* may be related to an adaptive tropic response to the incidence angles of annual sunlight, gravity, magnetism, or any combination of these (Loehle 1986, Christie and Murphy 2013). It is interesting that the pronounced lean in *A. columnaris* is rare in other species, including other *Araucaria* native to New Caledonia. It is possible that the biophysical constraints of

FIG. 3. Axial lean vs. latitude ($n = 256$). Axial lean gives a measure north-south component lean. It is calculated as the magnitude of lean multiplied by the cosine of the lean azimuth. Latitude is a strong predictor of axial lean ($R^2 = 0.543$, $F_{1,254} = 304.4$, $P << 0.001$). For clarity, we show the absolute value of axial lean separated for each hemisphere, so that increasing values indicate greater axial lean away from the equator.

Et nous avons aussi une *p*-valeur= 0.0253 pour les mesures par théodolite (voir page **Erreur ! Signet non défini.**) qui prouve aussi le globe.



Family Wise Error Rate (correction de Bonferroni)

En sciences dures et empiriques lorsque nous avons plusieurs *p*-valeurs de plusieurs expériences indépendantes et que nous voulons la *p*-valeur globale de la « meta-analyse » nous devons faire un calcul de FWER et la méthode la plus courante et basique et celle faisant usage de la correction de Bonferroni (Opera Magistris, 2024).

Le alpha ajusté de Bonferroni est en utilisant les trois *p*-valeurs ci-dessus {0.0253, 0.001, 0.00001} :

$$\alpha_{adj.} \cong 0.016667$$

Donc nous avons :

#	RAW P-VALUE	ADJUSTED P-VALUE	SIG. BEFORE (<A)?	SIG. AFTER (<A)?
1	0.0253	0.0759	✓ Yes	✗ No
2	0.001	0.003	✓ Yes	✓ Yes
3	0.00001	0.00003	✓ Yes	✓ Yes

Il s'ensuit que nous en concluons que majoritairement et selon la méthode scientifique moderne l'évidence pointe vers le globe !

(#394) Théorème Isopérimétrique

Le théorème isopérimétrique est un résultat de physique et mathématique qui, en termes simples, stipule que parmi toutes les figures géométriques ayant une surface donnée, la sphère est celle qui minimise la surface et donc l'énergie (le Lagrangien).

Or TOUTE la physique est basée sur le principe de moindre action – i.e. minimisation de l'action sur un chemin – comme expliqué dans (Opera Magistris, 2024) et n'a jamais été contredit par l'observation expérimentale.

L'inégalité isopérimétrique stipule qu'une sphère a la plus petite surface par volume donné. Étant donné un ouvert borné $S \subset \mathbb{R}^n$ de bord C^1, de surface $\mathrm{per}(S)$ et de volume $\mathrm{vol}(V)$, l'inégalité isopérimétrique stipule :

$$\mathrm{per}(S) \geq n \cdot \mathrm{vol}(S)^{\frac{n-1}{n}} \mathrm{vol}(B_1)^{1/n}$$

où $B_1 \subset \mathbb{R}^n$ est une boule unité. L'égalité est vraie lorsque S est une boule dans $\mathbb{R}^n$. Sous des restrictions supplémentaires sur l'ensemble (comme la convexité, la régularité, une frontière lisse), l'égalité est vraie pour une boule seulement. Mais en toute généralité, la situation est plus compliquée.

La démonstration est disponible dans : (Zum isoperimetrischen Problem, 1957).

La forme est donc une sphère et non pas un disque (plat).

Donc même les mathématiques pures contredisent donc les modèle du platisme !!!

translation into english ongoing

QUESTIONS THAT FLAT-EARTHERS PROPONENTS NEVER ANSWER

Here are a few simple questions that flattards **never** answer—either because they know the answer would be a lie, because they lack empirical data, or because, when there are several of them, they contradict one another:

1. Comment expliquez-vous le jour et la nuit et comment vous le reproduisez fidèlement expérimentalement ?
2. Quel est votre modèle mathématique détaillé qui explique le trajet de l'ombre d'un cadran solaire sur une Terre plate ?
3. De quoi est fait le dôme ?
4. Quelle est l'épaisseur de la Terre plate ?
5. Quel est le rayon de Lune ?
6. Quel est le rayon du Soleil ?
7. Comme expliquez-vous empiriquement et mathématiquement les éclipses de Lune ?
8. Quelle est la largeur de l'Antarctique ?
9. Pourquoi aucun platiste n'a réussi à photographier les pieds du pont Pont Alam Salam (Egypte) depuis le port Saïd (Egypte) ?
10. Reproduisez sur une Terre plate un coucher de Soleil où ce dernier disparaît alors que l'observateur est au-dessus du plan plat.
11. Comment est expliqué que les équations homographiques de la perspective linéaire soient violées sur le modèle de la Terre plate ?
12. Pourquoi la ligne d'horizon glisse en-dessous la ligne de vue au fur et à mesure qu'on prend de l'altitude alors que cela ne devrait pas être le cas sur une Terre plate ?
13. Quel est le modèle mathématique de la gravité de la Terre plate ?
14. À quelle hauteur est la Lune ?
15. À quelle distance est le Soleil ?
16. Quel est le modèle mathématique détaillé qui explique la forme de l'analème sur la Terre plate ?
17. Comment est expliqué et modélisé mathématiquement le mouvement rétrograde des planètes ?
18. Pourquoi le Soleil de la Terre plate viole la loi de Wien et la loi de Stefan-Boltzmann ?
19. Pourquoi le Soleil ne change-t-il pas de taille quand il s'éloigne à l'horizon et donc viole les lois de la perspective ?
20. Comment fonctionne la déflexion de la lumière ?
21. Comment les variations de températures saisonnières et journalières observées sont modélisées dans le modèle plat puisque le modèle globe l'explique très bien ?

translation into english ongoing

22. Comment sont calculées les lignes des champs du dipôle magnétique de la Terre plate ?
23. Pourquoi observe-t-on le transite de Vénus et de Mercure si le Soleil est local ?
24. Pourquoi les aiguilles des boussoles ne pointent pas vers le haut puisque la Terre est plate ?
25. Pouvez-vous prouver que chaque parallèle subtropical est supérieur aux parallèles de l'hémisphère Nord ?
26. Pourquoi observe-t-on une journée de 24 heures en Antarctique pendant plusieurs mois?
27. Pourquoi la construction de la totalité des accélérateurs de particules prend en comptent la courbure de la Terre ?
28. Pourquoi la construction de la totalité des détecteurs d'ondes gravitationnelles prend en comptent la courbure de la Terre ?
29. Pourquoi la construction des bassins de tests prend en compte la courbure lors de leur construction ?
30. Pourquoi lorsqu'on filme un coucher de Soleil avec un Nikon P1000 une fois ce dernier totalement derrière l'horizon on n'arrive pas à le faire réapparaître en zoomant ?
31. Pourquoi les meilleurs marins et navigateurs au Monde confirment et témoignent que la Terre est un globe ?
32. Pourquoi les meilleurs pilotes d'avions confirment et témoignent que la Terre est un globe ?
33. Quel est le modèle mathématique qui explique que le dipôle magnétique de la Terre plate viole les équations de Maxwell et que l'aiguille d'une boussole ne pointe pas vers le haut ?
34. Quel est modèle physique qui explique l'inversion des rotations des étoiles entre l'hémisphère Nord et l'hémisphère sur la Terre plate ?
35. Comment expliquez-que vous qu'on observe la nuit les étoiles du dôme qui entoure la Terre plate mais par contre pas le Soleil… ?
36. Quel est le rayon de la Terre plate et vérifions si les distances entre deux villes (par exemple dans le même pays) ou d'une île correspondent bien à ce que nous aurions avec le rayon de Terre plate donnée ?
37. Qu'est-ce qu'il y a au-delà des dômes qui entourent la Terre plate et en-dessous de la Terre plate ?
38. Les platistes ne croient pas dans la gravité mais dans la densité. La question est alors de quoi est composé le Soleil et la Lune sur leur Terre plate et comment vont-ils pour tenir en lévitation sous le dôme ?
39. Le modèle de la Terre plate suppose que le Soleil se déplace plus vite à travers le tropique du Capricorne (été dans l'hémisphère sud) que sous le tropique du Cancer. Cela a-t-il déjà été prouvé ou mesuré ?
40. Pourquoi la circonférence du 30^{e} méridien Nord (ou tout autre méridien) à la même circonférence que le 30^{e} méridien Sud. (ou tout autre méridien équivalent) ?
41. ……

translation into english ongoing

Donc y’a tellement de zones d’ombres et obscures dans le modèle de la Terre plate qu’il est évident que ces derniers vivent dans un dessin animé en dehors de la réalité !

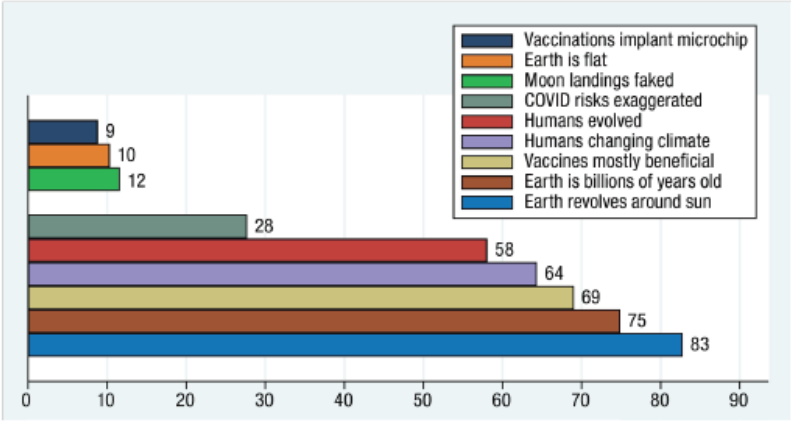
translation into english ongoing

CARSEY and YouGov RESEARCH

For those who are curious, here is a screenshot of the Carsey Research survey on the profile of a statistical (quite significant) sample of ~1,200 respondent about flat Earth in the U.S. (the report of high scientific quality but it's better than nothing…):

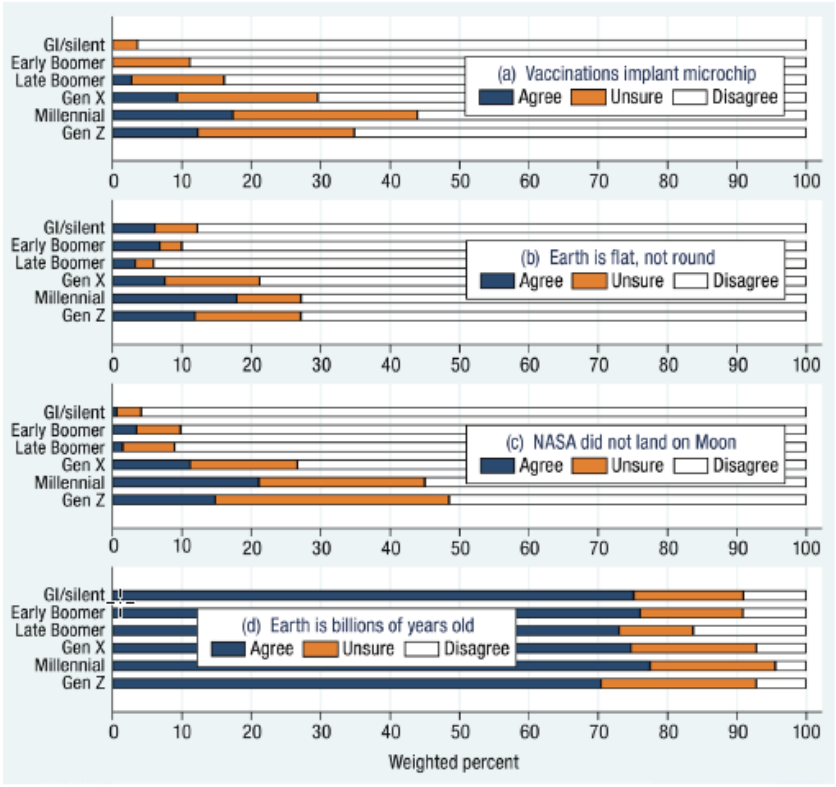
https://scholars.unh.edu/cgi/viewcontent.cgi?article=1449&context=carsey

FIGURE 2. PERCENT WHO AGREE WITH NINE CONSPIRACY OR SCIENTIFIC STATEMENTS



Source: POLES 2021 survey

FIGURE 4. RESPONSES TO FOUR CONSPIRACY OR SCIENCE STATEMENTS, BY GENERATION OF RESPONDENT



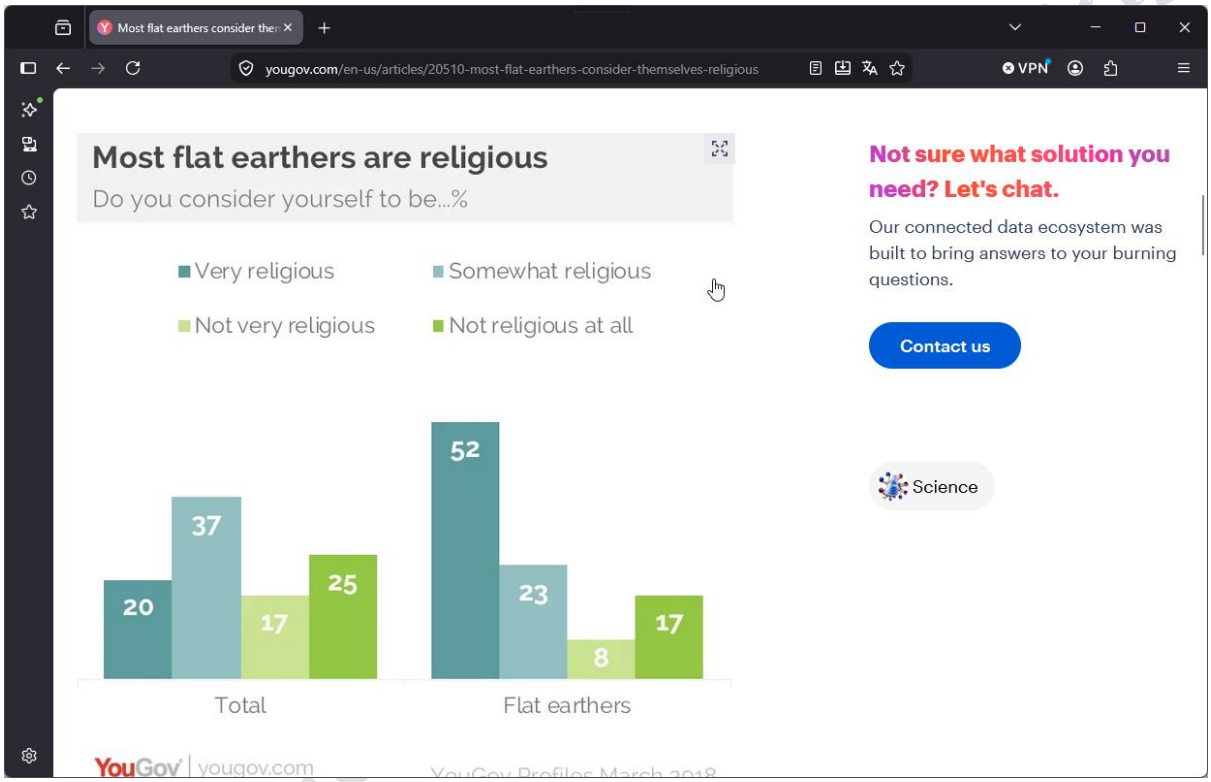
From YouGov (a global research data and analytics group) as available here:

https://yougov.com/en-us/articles/20510-most-flat-earthers-consider-themselves-religious

with some technical details of the survey here:

https://ygo-assets-websites-editorial-emea.yougov.net/documents/Flat20earth20March2025202018.pdf

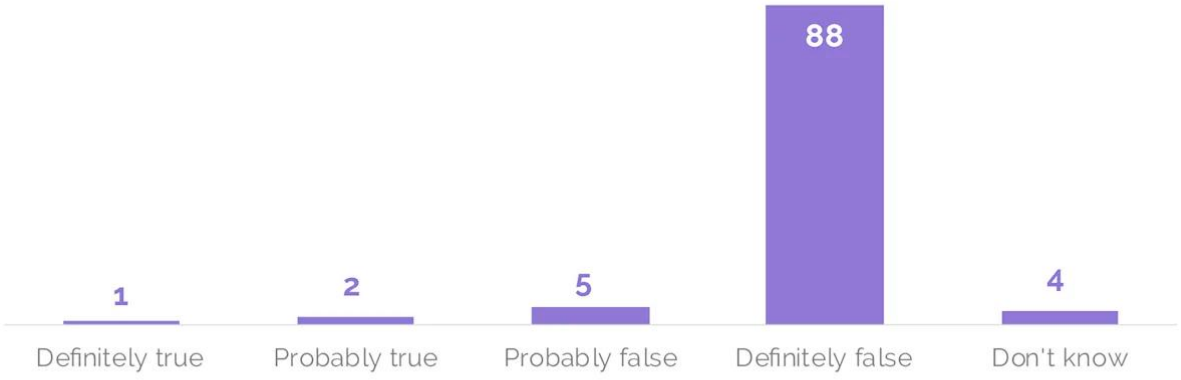
we have that the conclusion that most flattards in the U.S.A. (2% of U.S. citizens resolutely say the earth is flat) consider themselves very religious:



And still from YouGov, we have for Great Britain:

Three in a hundred Britons think the Earth is flat - and one in twenty say the theory is 'probably', but not 'definitely', false

To what extent, if at all, do you think the following statement is true or false? % Answers for 'the earth is flat'



YouGov | yougov.com

8 - 11 February, 2019

translation into englis

SYNTHESIS AND CONCLUSION

Now that we have presented over 380 pieces of evidence that the Earth is not flat, what can we conclude?

We have not only demonstrated beyond reasonable doubt that the Earth is not flat, but we have also provided evidence that the flat Earth hypothesis cannot work and that it is based on non-existent, inconsistent, and completely fabricated mechanisms that all contradict each other!

It is obvious that either the proponents of the flat Earth are people with a deficient scientific culture, or they are dishonest people who seek attention, or they spread disinformation for pecuniary reasons, or they are people who suffer from psychological problems, or they are religious people who do not accept that their religious texts revealed by their gods are wrong, which would transitively force them to admit that their gods do not exist, thus causing too much cognitive dissonance.

Il ne faut pas aussi oublier relativement à ce dernier point qu'une étude scientifique a montré que les enfants endoctrinés aux religions ne sont plus capables dans une certaine mesure de distinguer la réalité de la mesure et cela se poursuit chez un certain pourcentage encore à l'âge adulte (Judgments About Fact and Fiction by Children From Religious and Nonreligious Backgrounds, 2015) !

La compréhension des motivations derrière la supercherie de la Terre plate permet de mettre en lumière les enjeux politiques, économiques et sociétaux en jeu. Le modèle géocentrique (ou « idiotcentrique » …), en particulier, joue un rôle crucial dans la manière dont les individus perçoivent leur place dans l'univers observable. Les partisans de la Terre plate en promouvant une vision de l'humanité comme étant spéciale et unique dans un vaste univers sont orgueilleux et manquent totalement de recul pour faire de la Science honnête et sans biais. En promouvant une vision de l'humanité comme particulière dans un vaste cosmos, les élites religieuses manipulent les individus pour les enrôler dans leur secte et avoir des sources de revenus supplémentaires au détriment de la vérité et du vivre ensemble.

La répétition constante de messages dans divers canaux médiatiques et l'endoctrinement infantile conditionne les croyances et les perceptions des individus. Par exemple, la constante réaffirmation de la Terre Plate dans les réseaux sociaux renforce cette absurdité dans l'esprit collectif des gens manipulables ou endoctrinés. Cette technique vise à créer un faux consensus en rendant certains mensonges omniprésents et donc indiscutables.

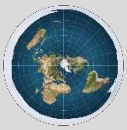
Utiliser des textes religieux ou des figures d'autorités religieuses dissuade aussi la remise en question et favorisent l'acceptation passive des théories mensongères.

Cela fait des milliers d'années que des partisans de la Terre plate existent et depuis 1881 que les premiers livres dédiés au sujet ont été publiés. Nous sommes aujourd'hui en 2025 et les partisans de la Terre plate sont toujours incapables de fournir des modèles physiques prédictifs, mathématiques ou informatiques cohérentes de leur paradigme… ni capables de publier des

translation into english ongoing

articles scientifiques validant leurs hypothèses avec les habituels NHST[17] (Opera Magistris, 2024) et des protocoles expérimentaux reproductibles. Cela en dit long sur leur niveau !

Tableau 1 Incohérence et Anomalies de la Terre plate

	Score		
1	Jour/Nuit	✓ OUI	❌ NON
2	Cadran Solaire	✓ OUI	❌ NON
3	Navigation Céleste	✓ OUI	❌ NON
4	Distances	✓ OUI	❌ NON
5	Visibilité étoiles polaires	✓ OUI	❌ NON
6	GPS	✓ OUI	❌ NON
7	Prédiction des ombres	✓ OUI	❌ NON
8	Trajectoire apparente de la Lune	✓ OUI	❌ NON
9	Montures équatoriales	✓ OUI	❌ NON
10	Vols circumpolaires	✓ OUI	❌ NON
11	Vols antipodaux	✓ OUI	❌ NON
12	Vols intra-hémisphérique	✓ OUI	❌ NON
13	Taille apparente du Soleil	✓ OUI	❌ NON
14	Compas	✓ OUI	❌ NON
15	Balistique	✓ OUI	❌ NON
16	Pendule de Foucault	✓ OUI	❌ NON
17	Gyroscope	✓ OUI	❌ NON
18	Expériences LASER	✓ OUI	❌ NON
19	Expériences Niveau à bulle	✓ OUI	❌ NON
20	Conservation de l'énergie	✓ OUI	❌ NON
21	Conservation du moment cinétique	✓ OUI	❌ NON
22	Objets réapparaissent quand on prend de la hauteur	✓ OUI	❌ NON
23	Éclipses de Lune	✓ OUI	❌ NON
24	Analème	✓ OUI	❌ NON
25	Angle de dépression	✓ OUI	❌ NON
26	Nuages noctulescents	✓ OUI	❌ NON
27	Projection des ombres des montagnes sur les nuages	✓ OUI	❌ NON
28	Soleil de minuit en Antarctique	✓ OUI	❌ NON
29	Force de Coriolis	✓ OUI	❌ NON
30	Effet d'Eötvös	✓ OUI	❌ NON
31	Transit de Vénus ou Mars	✓ OUI	❌ NON
32	Ne peut pas pointer vers la direction du Soleil à minut	✓ OUI	❌ NON

translation into english ongoing

[17] Null Hypothesis Statistical Tests

Il est difficile de faire abandonner sa croyance à une personne, surtout adulte. La croyance n'étant pas une démarche rationnelle, toute réfutation s'appuyant sur des arguments rationnels sera vaine. De plus, s'attaquer à la croyance de quelqu'un, en essayant de lui démontrer qu'il a tort, est vécu comme une agression ; pas seulement une agression intellectuelle mais une agression sociale envers sa communauté d'idée, une agression culturelle envers sa croyance. Remettre en cause ses idées platistes serait renier des années de confiance ou de réflexion et d'admettre un endoctrinement infantile et que leurs parents les ont donc menti toute leur vie.

translation into english ongoing

Choses qui doivent être fausses pour que la Terre plate soit vraie	Choses qui doivent être fausses pour que le Globe soit vrai
Astronomie	
Physique	
Astrophysique	
Géologie	
Séismologie	
Planétologie	
Ingénierie Spatiale	
G.P.S.	
Météorologie	
Navigation céleste	
Circumnavigation mondiale	
Géographie	
Cartographie	
Photographie	
Astronautes	
Réfraction	
Océanographie	
Géodésie	
Climatologie	
Satellites	
Radars	
Télescopes	
Observatoires	
Fonds gouvernementaux	
Ingénierie	

The Flat Earth theory and its supporters are therefore definitively knocked out!
Vae Victis

translation ongoing

Nous tenons à remercier les passionnés, ingénieurs et scientifiques sans lesquelles ce livret n'aurait pas été possible. Ce livret a été possible grâce à plusieurs siècles de recherche scientifique mais aussi grâce aux illustrations, animations, photos et vidéos faites entre 2006 et 2024 par des passionnés de la science qui se battent contre les mensonges et manipulations des partisans de la Terre plate.

Que l'obscurantisme retourne à l'obscurité !

translation into english ongoing

BIBLIOGRAPHY

Any educated person knows that failing to cite sources, and therefore lacking a scientific bibliography, is a characteristic of those who lack knowledge and manipulate others through deceitful and fallacious rhetoric or false analogies, in addition to using sophistry based on appeals to nature or authority without experimental evidence supported by raw data. Obviously, unlike flat-Earthers, here is the complete scientific bibliography of the various works mentioned throughout this booklet for those who wish to delve the subjects deeper!

A Manual of Spherical and Practical Astronomy: Spherical astronomy. **Chauvenet, William. 1874.** s.l. : JB Lippincott Company, 1874, Vol. 1.

A new determination of lunar orbital parameters, precession constant and tidal acceleration from LLR measurements. **Chapront, J and Chapront-Touzé, M and Francou, G. 2002.** [ed.] EDP Science. 2, 2002, Astronomy & Astrophysics, Vol. 387, pp. 700-709.

A novel estimator of Earth's curvature (allowing for inference as well). **Bell, David R and Ledoit, Olivier and Wolf, Michael. 2024.** 1, 2024, The Annals of Applied Statistics, Vol. 18, pp. 585-599.

Alignment and Survey of the Elements in RHIC. **Trbojevic, D and Cameron, P and Ganetis, GL and Goldman, MA and Gupta, R and Harrison, M and Hemmer, MF and Karl, FX and Jain, A and Louie, W and others. 1995.** [ed.] Proceedings Particle Accelerator Conference. 1995, IEEE, Vol. 4, pp. 2099-2101.

Alternative beliefs in psychedelic drug users. **Lebedev, A.V., Acar, K., Horntvedt, O. et al. 2023.** Sci Rep 13, 16432 , 2023, Nature.

Annibale Riccò and the catoptric proof of the Earth's curvature. **Nali, Pier Franco. 2022.** [ed.] England SAGE Publications Sage UK: London. 2022, Journal for the History of Astronomy, Vol. 53, pp. 88-119. 1.

Around-the-World Atomic Clocks: Predicted Relativistic Time Gains. **Keating, J. C. Hafele and Richard E. 1972.** 4044, 1972, Science, Vol. 177, pp. 166-168.

Atmospheric phenomena before and during sunset. **Menat, M. 1980.** 20, s.l. : Optica Publishing Group, 1980, Applied Optics, Vol. 19, pp. 3458-3468.

Bayesian inference for statistical abduction using Markov chain Monte Carlo. **Ishihata, Masakuzu and Sato, Taisuke. 2011.** 2011, Asian Conference on Machine Learning (PMLR), pp. 81-96.

Beiträge zum gesetze der proportionalität von trägheit und gravität. **R. V. Eötvös, D. Pekar and E. Fekete. 1922.** [ed.] WILEY-VCH Verlag Leipzig. 9, 1922, Annalen der Physik, Vol. 373, pp. 11-66.

Bounding the Speed of Gravity with Gravitational Wave Observations. **Neil Cornish, Diego Blas, and Germano Nardini. 2017.** 119, 10 18, 2017, Physical Review Letters, Vol. 161102.

translation into English ongoing

Correction of optical distance measurements for the fluctuating atmospheric index of refraction. **Bender, Peter L and Owens, James C. 1965.** [ed.] Wiley Online Library. 10, 1965, Journal of geophysical research, Vol. 70, pp. 2461-2462.

Crepuscular rays: laboratory experiments and simulations. **Vollme, Stanley David Gedzelman and Michael. 2011.** 28, s.l. : Applied Optics, 9 30, 2011, Applied Optics, Vol. 50, pp. F142-F151.

Definitions of Surveying and Associated Terms. **Genovese, Ilse. 2005.** s.l. : American Congress on Surveying and Mapping, 2005.

Distance of the Visible Horizon. **Tizard, TH. 1913.** 2299, 1913, Nature, Vol. 92, pp. 344-345.

Dunning–Kruger effect and flat-earthers: An exploratory analysis. **Arroyo-Barrigüete, J. L., Bellón Núñez-Mera, C., Labrador Fernández, J., & De Nicolas, V. L. 2023.** [ed.] England SAGE Publications Sage UK: London. 7, 2023, Public Understanding of Science, Vol. 32, pp. 835-844.

Earth curvature and atmospheric refraction effects on radar signal propagation. **Doerry, Armin Walte. 2013.** s.l. : Sandia National Lab.(SNL-NM), Albuquerque, NM (United States), 2013.

Eratosthenes 2009/2010: An old experiment in modern times. **Bekeris, Victoria and Bonomo, Flavia and Bonzi, Edgardo and Garcìa, Beatriz and Mattei, Guillermo and Mazzitelli, Diego and Dawson, Silvina Ponce and Vega, CSF and Tamarit, Francisco. 2011.** 1, s.l. : American Astronomical Society, 2011, Astronomy Education Review, Vol. 10, p. 010201.

Estimating target heights based on the Earth curvature model and micromultipath effect in skywave OTH radar. **Chengyu, Hou and Yuxin, Wang and Jiawei, Chen. 2014.** [ed.] Wiley Online Library. 1, 2014, Journal of Applied Mathematics, Vol. 2014, p. 424191.

Evidence of lunar phase influence on global surface air temperature. **Anyamba, Ebby K and Susskind, Joel. 2000.** [ed.] Wiley Online Library. 18, 2000, Geophysical research letters, Vol. 27, pp. 2969-2972.

Experimenteller Nachweis der Schwereänderung, die ein auf normal geformter Erdoberfläche in östlicher oder westlicher Richtung bewegter Körper durch diese Bewegung erleidet. **Eötvös, Roland. 1919.** [ed.] Wiley Online Librar. 16, 1919, Annalen der Physik, Vol. 364, pp. 743-752.

Global P wave tomography of Earth's lowermost mantle from partition modeling. **M. K. Young, H. Tkalčić, T. Bodin, M. Sambridge. 2013.** 10, 2013, Journal of Geophysical Research: Solid Earth, Vol. 118, pp. 5467-5486.

Gravity probe B: final results of a space experiment to test general relativity. **Everitt, CW Francis and DeBra, DB and Parkinson, BW and Turneaure, JP and Conklin, JW and Heifetz, MI and Keiser, GM and Silbergleit, AS and Holmes, T and Kolodziejczak, J and others. 2011.** [ed.] APS. 22, 2011, Physical Review Letters, Vol. 106, p. 221101.

Gravity waves generated by the Hunga Tonga--Hunga Ha' apai volcanic eruption and their global propagation in the mesosphere/lower thermosphere observed by meteor radars and

translation into english ongoing

modeled with the High-Altitude general Mechanistic Circulation Model. **Stober, Gunter and Vadas, Sharon L and Becker, Erich and Liu, Alan and Kozlovsky, Alexander and Janches, Diego and Qiao, Zishun and Krochin, Witali and Shi, Guochun and Yi, Wen and others. 2024.** 8, s.l. : Copernicus Publications G{\"o}ttingen, German, 2024, Atmospheric Chemistry and Physics, Vol. 24, pp. 4851-4873.

Height, structure and displacements of noctilucent clouds. **Witt, Georg. 1962.** [ed.] Tellus. 1, s.l. : Taylor & Francis, 1962, Vol. 14, pp. 1-18.

Implementation of Bessel's method for solar eclipses prediction in the WRF-ARW model. **Montornès, A., Codina, B., Zack, J. W., & Sola, Y. 2016.** [ed.] Atmospheric Chemistry and Physics. 9, 2016, Vol. 16.

Introduction to Wireless Communications and Networks: A Practical Perspectiv. **Raghunandan, Krishnamurthy. 2022.** s.l. : Springer, 2022, pp. 277-296.

Judgments About Fact and Fiction by Children From Religious and Nonreligious Backgrounds. **Corriveau, K. H., Chen, E. E., & Harris, P. L. 2015.** 2015, Cognitive Science, Vol. 39(2), pp. 353-382.

Kuzii, Olena and Rovenchak, Andrij. 2019. *What the gravitation of a flat Earth would look like and why thus the Earth is not actually flat.* s.l. : IOP Publishing, 2019. p. 035008. Vol. 40. 3.

Lynch, David K. 2005. *Turbulent ship wakes: further evidence that the Earth is round.* [ed.] Applied Optics. 2005. pp. 5759-5762. Vol. 44.

Measurement of the neutrino velocity with the OPERA detector in the CNGS beam. **Adam, Thomas and Agafonova, N and Aleksandrov, A and Altinok, O and Alvarez Sanchez, P and Anokhina, A and Aoki, S and Ariga, A and Ariga, T and Autiero, D and others. 2012.** [ed.] Springer. 10, 2012, Journal of High Energy Physics, Vol. 2012, pp. 1-37.

Measuring and Modeling the Effect of Surface Moisture on the Spectral Reflectance. **Nolet, C and Poortinga, A and Roosjen, P and Bartholomeus, H and Ruessink, G. 2014.** 2014, Public Library of Science (PLOS).

Modeling and predicting tides over the World Ocean. **Le Provost, Christian and Genco, Marie-Laure and Lyard, Florent. 1995.** s.l. : Wiley Online Library, 1995, Quantitative skill assessment for coastal ocean models, Vol. 47, pp. 175-201.

Motivated ignorance and social identity threat: the case of the Flat Earth. **Jones, I., Adams, A., & Mayoh, J. 2023.** 29(1), 2023, Social Identities, Vol. 29, pp. 79–94.

Night sky brightness at observatories and sites. **Garstang, RH. 1989.** [ed.] IOP Publishing. 637, 1989, Publications of the Astronomical Society of the Pacific, Vol. 101, p. 306.

Observations of Earth--ionosphere cavity resonances. **Balser, Martin and Wagner, Charles A. 1960.** [ed.] Nature Publishing Group UK Londo. 4751, 1960, Nature, Vol. 188, pp. 638-641.

translation into english ongoing

Ocean tides, part I: global ocean tidal equations. **Schwiderski, Ernst W. 1980.** 1-4, s.l. : Taylor & Francis, 1980, Marine Geodesy, Vol. 3, pp. 161-217.

Opera Magistris. **Collectif. 2024.** August 2024, p. 8919.

—. **Collectif. 2024.** August 2024, p. 8919.

Orientation of high-resolution satellite images based on affine projection. **S Hattori, T Ono, C Fraser, H Hasegawa. 2000.** B3, 2000, International Archives of Photogrammetry and Remote Sensing, Vol. 33, pp. 359-366.

Planetary theories in rectangular and spherical variables-VSOP 87 solutions. **Bretagnon, Pierre and Francou, Gérard.** 1-2, Astronomy and Astrophysics, Vol. 202, pp. 309-315.

Robert Henry Scott, F. R. S. *Note on a series of barometrical disturbances which passed over Europe between the 27th and the 31st of August, 1883.* pp. Proc. R. Soc. (1883) 36 (228-231): 139–143.

Size and shape of a celestial body, definition of a planet. **Probsthain, Konrad. 2018.** 2018, arXiv preprint arXiv:1807.08593.

Standard values for the solar constant and its spectral components. **Thekaekara, MP and Drummond, AJ. 1971.** 1, s.l. : Nature Publishing Group UK London, 1971, Vol. 229, pp. 6-9.

Sun is a light 32 Miles Across. **Charles K. Johnson, Marjory Waugh Johnson. 1978.** California : Flat Earth News, Décembre 1978, p. 1.

The centennial of the Sagnac experiment in the optical regime: From a tabletop experiment to the variation of the Earth's rotation. **Schreiber, Karl Ulrich and Gebauer, Andr{\'e} and Igel, Heiner and Wassermann, Joachim and Hurst, Robert B and Wells, Jon-Paul R}. 2014.** 10, 2014, Comptes Rendus. Physique, Vol. 15, pp. 859-865.

The diffraction of radio waves by the curvature of the Earth. **Pryce, MHL. 1953.** [ed.] Taylor & Francis. 5, 1953, Advances in Physics, Vol. 2, pp. 67-95.

The Earth Is Not Flat: An Analysis of a Sunset Photo. **Vanderbei, Robert J. 2008.** November 2008, Optics and Photonics News, pp. 34-39.

The earthquake of Tokio, April 18, 1889. **von Rebeur-Paschwitz, E. 1889.** s.l. : Nature Publishing Group UK Londo, 1889, Nature, Vol. 40.

The effects of urban lighting on the brightness of the night sky. **Walker, Merle F. 1977.** 529, s.l. : IOP Publishing, 1977, Publications of the Astronomical Society of the Pacific, Vol. 89, p. 405.

The lunar ephemeris ELP 2000. **Chapront-Touzé, Michelle and Chapront, Jean. 1983.** 1, Juillet 1983, Astronomy and Astrophysics, Vol. 124, pp. 50-62.

translation into english ongoing

The Mongol Empire's Northern Border: Re-evualting the Surface Area of the Mongol Empire. **Pow, Stephen. 2018.** [ed.] Dóra Mérai. s.l. : Archeoloingua, 2018, pp. 8-13. 978-615-5766-19-0.

The Recent Advance in Seismology. **Hobbs, William Herbert. 1907.** 4, s.l. : University of Chicago Press, 1907, The Journal of Geology, Vol. 15, pp. 396-409.

The Rotundity of the Earth. **1870.** s.l. : Nature, 4 7, 1870, p. 581.

The Saros cycle: obtaining eclipse periodicity from Newton's laws. **Chalub, Fabio ACC. 2009.** [ed.] SciELO Brasil. 2009, Revista Brasileira de Ensino de Fisica, Vol. 31, pp. 1303-1.

The Shape of Celestial Objects. **Rahn, Perry H and Durkin, Thomas V. 2016.** 2016, Proceedings of the South Dakota Academy of Science, Vol. 95.

The sporadic radiant and distribution of meteors in the atmosphere as observed by VHF radar at Arctic, Antarctic and equatorial latitudes. **Younger, PT and Astin, Ivan and Sandford, David J and Mitchell, Nicholas J. 2009.** 7, s.l. : Copernicus Publications Göttingen, Germany, 2009, Annales Geophysicae, Vol. 27, pp. 2831-2841.

Tidal locking and the gravitational fold catastrophe. **Ferroglia, Andrea and Fiolhais, Miguel CN. 2020.** 12, s.l. : AIP Publishing, 2020, American Journal of Physics, Vol. 88, pp. 1059-1067.

Tidal prediction using the advanced circulation model (ADCIRC) and a relocatable PC-based system. **Blain, CA and Preller, RH and Rivera, AP. 2002.** 1, s.l. : Citeseer, 2002, Oceanography, Vol. 15, pp. 77-87.

Toward a Cultural Psychology of Conspiracy Theories:. **Kirstine Pahuus, Maja Sødinge Jørgensen, Brady Wagoner. 2024.** 2024, Integrative Psychological and Behavioral Science, Vol. 58, pp. 1895–1913.

Worldwide hemisphere-dependent lean in Cook pines. **Johns, Jason W and Yost, Jennifer M and Nicolle, Dean and Igic, Boris and Ritter, Matt K. 2017.** 9, 2017, Ecology, Vol. 98.

Zum isoperimetrischen Problem. **Baebler, F. 1957.** 1, s.l. : Springer, 1957, Archiv der Mathematik, Vol. 8, pp. 52-65.

translation into english ongoing

Summary of DOI numbers

If necessary, here is the list of DOI numbers for the publications and works mentioned above (because to prove that one of the pieces of evidence mentioned in this PDF is false, it is necessary to demonstrate that the content of the corresponding scientific paper is false and therefore that it is retracted by its publisher!):

(1) DOI:10.1038/001581a0 The Rotoundity of the Earth (1870), Nature

(2) DOI:10.3847/AER2011007, Eratosthenes 2009/2010: An old experiment in modern times (2011), Astronomy Education Review

(3) DOI:10.2139/ssrn.4406724, A novel estimator of Earth's curvature (2024), The Annals of Applied Statistics

(4) DOI:10.5670/oceanog.2002.38, Tidal prediction using the advanced circulation model (ADCIRC) and a relocatable PC-based system (2002), Oceanography

(5) DOI:10.5281/zenodo.5816819, Opera Magistris (2024)

(6) DOI:10.1119/10.0001772, Tidal locking and the gravitational fold catastrophe (2020), American Journal of Physics

(7) DOI:10.1109/ICASSP.2014.6854022, The Recent Advance in Seismology (1907), The Journal of Geology

(8) DOI:10.1016/j.crhy.2014.10.003, The centennial of the Sagnac experiment in the optical regime: From a tabletop experiment to the variation of the Earth's rotation (2014), Comptes Rendus Physique

(9) DOI:10.1088/1361-6404/ab0bba, What the gravitation of a flat Earth would look like and why thus the Earth is not actually flat (2019), IOP Publishing

(10) DOI:10.1029/CE047p0175, Modeling and predicting tides over the World Ocean (1995), Wiley Online Library

(11) DOI:10.1364/AO.44.005759, Turbulent ship wakes: further evidence that the Earth is round (2005), Optics Applied

(12) DOI:10.5194/acp-16-5949-2016, Implementation of Bessel's method for solar eclipses prediction in the WRF-ARW model (2016), Atmospheric Chemistry and Physics

(13) DOI:10.1002/jgrb.50391, Global P wave tomography of Earth's lowermost mantle from partition modeling (2013), Journal of Geophysical Research

(14) DOI:10.1364/AO.19.003458, Atmospheric phenomena before and during sunset (1980), Applied Optics

(15) DOI:10.1177/002182862110496, Annibale Riccò and the catoptric proof of the Earth’s curvature (2022), Journal for the History of Astronomy

translation into english ongoing

(16) DOI:10.1103/PhysRevLett.119.161102, Bounding the Speed of Gravity with Gravitational Wave Observations (2017), Physical Review Letters

(17) DOI:10.1371/journal.pone.0112151, Measuring and Modeling the Effect of Surface Moisture on the Spectral Reflectance (2014), Public Library of Science

(18) DOI:10.48550/ARxIv.1807.08593, Size and shape of a celestial body, definition of a planet (2018), arXiv preprint

(19) DOI:10.1080/01490418009387997, Ocean tides, part I: global ocean tidal equations (1980), Marine Geodesy

(20) DOI:10.1038/physci229006a0, Standard values for the solar constant and its spectral components (1971), Nature Publishing Group UK London

(21) DOI:10.1038/092425d0, Distance of the Visible Horizon (1913), Nature

(22) DOI:10.1109/PAC.1995.505467, Alignment and Survey of the Elements in RHIC (1995), IEEE

(23) DOI:10.1364/OPN.19.11.000034, The Earth Is Not Flat: An Analysis of a Sunset Photo (2008), Optics and Photonics News

(24) DOI:10.1364/AO.50.00F142, Crepuscular rays: laboratory experiments and simulations (2011), Applied Optics

(25) DOI:10.1177/09636625231166255 Dunning–Kruger effect and flat-earthers: An exploratory analysis (2002), SAGE Publications

(26) DOI:10.1111/cogs.12138, Judgments About Fact and Fiction by Children From Religious and Nonreligious Backgrounds (2015), Cognitive Science

(27) DOI:10.1007/BF01898439, Zum isoperimetrischen Problem (1957), Archive Maths

(28) DOI:10.1007/JHEP10(2012)093, Adam, T., Agafonova, N. et al. Measurement of the neutrino velocity with the OPERA detector in the CNGS beam. J. High Energ. Phys. 2012, 93 (2012)

(29) DOI: 10.1103/PhysRevLett.106.221101, C. W. F. Everitt, D. B. DeBra, B. W. Parkinson, J. P. Turneaure, J. W. Conklin, M. I. Heifetz, G. M. Keiser, A. S. Silbergleit1, and T. Holmes et al., Gravity Probe B: Final Results of a Space Experiment to Test General Relativity (2011), Physical Review Letters

(30) DOI:10.5194/acp-24-4851-2024, Stober, Gunter and Vadas, Sharon L and Becker, Erich and Liu, Alan and Kozlovsky, Alexander and Janches, Diego and Qiao, Zishun and Krochin, Witali and Shi, Guochun and Yi, Wen and others, Gravity waves generated by the Hunga Tonga--Hunga Ha′ apai volcanic eruption and their global propagation in the mesosphere/lower thermosphere observed by meteor radars and modeled with the High-Altitude general Mechanistic Circulation Model (2024), Atmospheric Chemistry and Physics

translation into english ongoing

(31) DOI:10.1155/2014/424191, Hou Chengyu, Wang Yuxin, Chen Jiawei, Estimating Target Heights Based on the Earth Curvature Model and Micromultipath Effect in Skywave OTH Radar (2014), Journal of Applied Mathematics

(32) DOI:10.2172/1088060, Doerry, Armin Walter, Earth curvature and atmospheric refraction effects on radar signal propagation (2013), U.S. Department of Energy Office of Scientific and Technical Information

(33) DOI:tellusa.v14i1.9524, Height, structure and displacements of noctilucent clouds (1962), Taylor & Francis

(34) DOI:10.1038/188638a0, Balser, Martin and Wagner, Charles A, Observations of Earth--ionosphere cavity resonances (1960), Nature

(35) DOI:10.1126/science.177.4044.166, J. C. Hafele and Richard E. Keating, Around-the-World Atomic Clocks: Predicted Relativistic Time Gains (1972), Science

(36) DOI:10.1029/2000GL011651, Ebby K. Anyamba, Joel Susskind, Evidence of lunar phase influence on global surface air temperature (2000), Advancing Earth and Space Sciences

(37) DOI:10.1029/JZ070i010p02461, Peter L. Bender, James C. Owens, Correction of optical distance measurements for the fluctuating atmospheric index of refraction (1965), Journal of Geophysical Research

(38) DOI:10.1002/andp.19193641604, Eötvös, Loránd, Experimenteller Nachweis der Schwereänderung, die ein auf normal geformter Erdoberfläche in östlicher oder westlicher Richtung bewegter Körper durch diese Bewegung erleidet (1919), Annalen der Physik

(39) DOI:10.1002/andp.19223730903, R. V. Eötvös, D. Pekar and E. Fekete, Beiträge zum gesetze der proportionalität von trägheit und gravität (1922), Annaler de Physik

(40) DOI:10.1007/978-3-030-92188-0, Raghunandan, Krishnamurthy, Introduction to Wireless Communications and Networks: A Practical Perspectiv (2022), Springer

(41) DOI:10.1086/130142, M. F. Walker, The effects of urban lighting on the brightness of the night sky (1977), Astronomical Society of the Pacific

(42) DOI:10.1086/132436, R. H. Garstang, Night sky brightness at observatories and sites (1988), Astronomical Society of the Pacific

(43) DOI:10.1002/ecy.1850, Jason W. Johns, Jennifer M. Yost, Dean Nicolle, Boris Igic, Matt K. Ritter, Worldwide hemisphere-dependent lean in Cook pines, Ecology, 0(0), 2017, pp. 1–3, The Scientific Naturalist

(44) DOI:10.1098/rspl.1883.0087, Robert Henry Scott, F. R. S., *Note on a series of barometrical disturbances which passed over Europe between the 27th and the 31st of August*, 1883, Proc. R. Soc. (1883) 36 (228-231): 139–143

translation into english ongoing

(45) DOI: 10.21474/IJAR01/16210, Mohd Hafiz Safiai, Mohd Izhar Ariff Mohd Kashim, Md Yazid Ahmad1, Ezad Azraai Jamsari, Mohamad Zulfazdlee Abul Hassan Ashari and Anwar Muttaqin, *Diversité des fuseaux horaires au burj khalifa : prières et jeûne dans les gratte-ciel, International Journal of Advanced Research (IJAR)*, 11(01), 1808-1812, 31.12.2022

translation into english ongoing

TABLE OF FIGURES

Figure 1 Non-composite satellite photo of Earth by Himawarri-8 (source: JAXA).....20

Figure 2 Photo taken with a camera on board of North Korea's Hwasong-12 missile during a test launch in January 2022 (Image credit: NKNews.org/KCNA) 22

Figure 3 Non-composite photo of the Earth from the Meteosat Third Generation satellite – Imager 1 MTG-I1 (source: ESA/EUMETSAT) 23

Figure 4 Non-composite photo of Earth from the Russian weather satellite Elecktro-L (source ROSCOSMOS).....24

Figure 5 Photo of Earth by Chandraya-1 (source: ISRO).....25

Figure 6 Non-composite photo of the Earth taken in November 2014 (source CNSA).....26

Figure 7 Non-composite photo of Earth from Apollo 17 (source: NASA) 28

Figure 8 Observation of Chicago from the Manistique lighthouse has not been possible to date (August 2018, author: frtliner).....36

Figure 9 Dervin Bay Sea / Grand Blockhouse (author: Didier Desroches, source: Google Earth) 37

Figure 10 Photos depuis les falaises de l'île Rousse/Corsica (auteur : Laulau.2a).....38

Figure 11 Chillon Castle (© Swiss-Image.ch, Sébastien Staube).....40

Figure 12 A variety of small bodies in the solar system, to scale (source: Wikipedia/Antonio Ciccolella).....50

Figure 13 Dimensions of the real oblate vs. imaginary flat Earth (auteur : StingRay).....53

Figure 14 Photo of the heights of Corsica at dawn on Tuesday, January 15, 2019 from Cagnes sur Mer at an altitude of 78 meters (author : John Bouchet, www.johnb.fr).....61

Figure 15 Photo of Corsica from the heights of Nice (author : John Bouchet https://andrieu.photos/corse).....61

Figure 16 Dawn temperatures at the Nice sensor 63

Figure 17 Dawn temperatures at the Corte sensor 64

Figure 18 Mount Canigou from Marseille late afternoon on Friday October 11 (photo : Laurent Ferrero, source : http://splendeursducielprofond.eklablog.fr) 67

Figure 19 Geographic location/distance Mont Canigou to Allauch (source : http://canigou.allauch.free.fr).....69

translation into english ongoing

Figure 20 Comparison of totality vs hidden height from Allauch (source : http://canigou.allauch.free.fr).....69

Figure 21 Lac Pontchartrain en Louisiane aux États-Unis avec Nikon P1000.....82

Figure 22 This photo of the offshore wind farm taken on July 14, 2018, off the Belgian coast perfectly shows the curvature of the Earth (author: Lieven, source: Wikipedia).....85

Figure 23 Two Pacific white-sided dolphins race toward the viewer, away from seven oil derricks behind them in the Santa Barbara Channel.....88

Figure 24 High voltage power line at Pontchartrain.....92

Figure 25 (Exaggerated) illustration of the Earth's curvature on a cable-stayed bridge (source: Math Encounters Blog).....94

Figure 26 Verrazon-Narrows Bridge (author: Ajay Suresh, source: Wikipedia).....95

Figure 27 (Exaggerated) illustration of the Earth's curvature on a cable-stayed bridge (source: Math Encounters Blog).....96

Figure 28 Humber Bridge.....97

Figure 29 Akashi Strait Bridge (source : Wikipédia, auteur : H.Oomor).....98

Figure 30 David Taylor's Modeling Basin in Maryland / Washington DC (USA).....101

Figure 31 Southampton Hydro-Scientific facility (© Jim Stephenson).....104

Figure 32 Cozumel Island from Playa Del Carmen, Mexico, and a view from the open sea (author: ?).....108

Figure 33 Topography of the Bonneville Salt Flats (source : https://fr-fr.topographic-map.com/).....110

Figure 34 Sunset from the Burj Khalifa (author : Simon Bierwald, Nikon D800, 3 december 2014, source : Flickr).....112

Figure 35 Source : “Mathias Kp”, preview image of “Ship sailing into the horizon”, YouTube, February 2016.....128

Figure 36 Illustration of what happens when a boat disappears below the horizon (source: http://canigou.allauch.free.fr).....128

Figure 37 Courbure de la Terre sur le lac de Constance le 15 août 2009 (source : Wikipédia).....129

Figure 38 Sun and MSC container ship disappearing below the horizon (photo: Charles Messier, April 19, 2025, from Wimereux, Pas de Calais, facing the English Channel (France), 1600 mm focal length, Sony A7s (in APC-C) + 1060 mm telescope).....133

translation into english ongoing

Figure 39 Plane landing and taking off from Oakland International Airport (author: Scott McPeak) 148

Figure 40 Illustration (not to scale and simplified) of Eratosthenes' experiment (author: Raphael Javaux, source: Wikipedia) 151

Figure 41 Schools and students participating in the global Eratosthenes project (source: https://fondation-lamap.org/en/participez/the-eratosthenes-project) 152

Figure 42 Statue of al-Biruni in Iran - a Shia majority country (note the globes...) 154

Figure 43 Down from Nandana Fort 155

Figure 44 Archaeological remains of the present Nandana Fort 156

Figure 45 Old Bedford River (source: Wikipedia) 158

Figure 46 Panorama of Rainy Lake in winter 2018 with George Khan's dog next to the snowmobile 160

Figure 47 Rainy Lake Target Locations for the experiment 160

Figure 48 Albert W. Stevens' 1935 film photograph of the Earth's curvature 162

Figure 49 Aristarchus's calculations of the relative sizes of the Sun, Earth, and Moon, 3rd century BC, from a 10th-century Greek copy (source: Wikipedia) 166

Figure 50 The Horizon-o-Matic experiment (source: https://mctoon.net) 168

Figure 51 Kip Daugirdas, Noah Joraanstad and Joe Hepworth hoist MESOS onto the launch tower 184

Figure 52 Shadow of sticks on a flat Earth (author: Jos Leys) 187

Figure 53 Wing view of an Emirates Boeing 777-300ER, registration A6-EGO. Sunrise seen on flight 564 from Dubai DXB to Bengaluru BLR on July 5, 2015 (source: Wikipedia) 197

Figure 54 Lufthansa Airbus A321-231 on February 15 - September 17, 1999 (author: Jonathan Palombo, source: D-AISB) 199

Figure 55 Flight from Frankfurt am Main (FRA) to Schiphol Amsterdam (AMS) on January 10, 2012 at 5:01 PM (51° 04′ 45.73″ N, 7° 02′ 17.22″ E) (author: Edgar Jiménez from Porto, Portugal, source: Flickr) 200

Figure 56 U.S. Department of State, Secretary John Kerry's view from the plane as he flies over the Red Sea in May 24, 2013 (source: Flickr) 201

Figure 57 The U2 Dragon Lady 204

Figure 58 Hafele and Keating aboard a commercial airliner, with two of the atomic clocks 224

Figure 59 Principle of the gyroscope in the Gravity Probe B probe 225

translation into english ongoing

Figure 60 Rotor and housing of the gyroscope of the Gravity Probe B experiment with housing 225

Figure 61 Gravity Probe B before launch (source: NASA) 226

Figure 62 Flight routes from Earth to Globe vs. Flat Earth (source: FlatEarth.ws/southern-flight).....231

Figure 63 World tours via the poles by plane (source : https://flatearth.ws/polar-circumnav) 232

Figure 64 One More Orbit's journey over the poles (illustration courtesy of One More Orbit) 238

Figure 65 Antipodal flights Madrid-Auckland (source: https://flatearth.ws/auckland-madrid) 239

Figure 66 Antipodal flights Madrid-Auckland (https://flatearth.ws/auckland-madrid) 241

Figure 67 Flight data QF6051/14 Brisbane-Buenos Aires-Darwin 278

Figure 68 Lisa Blair's Roads © Carolyn Grant 292

Figure 69 Official Jules Verne Trophy records https://www.tropheejulesverne.org/courses/ 293

Figure 70 Crepuscular rays (author: Brocken Inaglory, source: Wikipedia).....296

Figure 71 Variation in the apparent size of the Sun (source: NASA) 301

Figure 72 Full cycle of a sunset over the high plains of the Mojave Desert on June 6, 2015 (author: Jessie Eastland) 307

Figure 73 The moon sets at night over the North Atlantic off Brighton (author: Dominic Alves) 308

Figure 74 Solar eclipse nonsense on a flat Earth depicted.....310

Figure 75 Real analemma and its positions in 24 Solar Terms (author: ©Matthew Chin)....313

Figure 76 The orthogonal projection of the solar trajectory for the location (re-edited: (Abu Dhabi, 24.5° N, 54.4° W) obtained by the Sun Chart calculator [UK SML, 2007]) 321

Figure 77 Apparent path of the sun (photo: Regina Valkenborgh) 322

Figure 78 Apparent movements of the Sun (source : https://flatearth.ws/t/sun-path) 324

Figure 79 Equinoxes (source : Wikipédia, auteur : Tau'olunga) 330

Figure 80 Sun Tracker 335

translation into english ongoing

Figure 81 Solstices and equinoxes and sunlight in the flat-Earth paradigm (source : flatearth.ws/day-night/area) 354

Figure 82 EUMETSAT solstices and equinoxes 356

Figure 83 2012, Mount Rainier, Washington/U.S.A. (author : PCloadletter26) 360

Figure 84 Mont Hood, Oregon/U.S.A. (author : Alex Zimmerman) 361

Figure 85 Mont Voisin/France (11 mars 2016, author : Olivier Joseph) 361

Figure 86 Pointe des Neyzets/France (5th November 2017 at 4:03 PM, author : Olivier Joseph) 362

Figure 87 Visibility conditions of noctilucent clouds from the Earth's surface 366

Figure 88 Photo taken with a Nikon Z6 with a Zeiss 100/2 lens from Fort Alban (Nice) on September 29, 2024 at 06:33:20 local time (credit: Christophe S.) 369

Figure 89 The inner planets. From left to right: Mercury, Venus, Earth, Mars, and the terrestrial dwarf planet Ceres (sizes to scale, source: Wikipedia) 380

Figure 90 The planet Venus appears as a small black dot as it passes in front of the face of the Sun on June 8, 2004 (author: Ian Waldie) 381

Figure 91 Curved beams of light and time zones on a flat Earth 391

Figure 92 Notre-Dame Clock in Strasbourg (France) 392

Figure 93 Administrative time zones illustrated on a globe (author: Serhii Bilyk, source: Shutterstock) 392

Figure 94 The five Lagrange points in the Sun-Earth-Moon triplet (author: Matthew Twombly) 395

Figure 95 Observation satellites at Lagrange points L1 and L2 (source: Astronomy/Royen Kelly) 396

Figure 96 Geostationary satellites (author Bob King, source: Sky & Telescope) 397

Figure 97 Principle of stereoscopic measurement with a SPOT satellite 402

Figure 98 On the left, the appearance of a lunar eclipse on a hypothetical flat Earth. On the right, what actually happens (credit: JL Dauvergne). 404

Figure 99 During a total lunar eclipse, the Moon appears to turn red as it passes through the Earth's shadow (photo credit: Anantha Jois via Getty Images) 407

Figure 100 Variation in apparent size of the Moon (source: Wikipedia) 408

Figure 101 Maximum visibility of the January 2019 lunar eclipse (author: Jos Leys) 414

translation into english ongoing

Figure 102 Directional vectors for observing the January 2019 lunar eclipse (author: Jos Leys) 415

Figure 103 Extension of the observation direction vectors of the January 2019 lunar eclipse (author: Jos Leys).....416

Figure 104 Extension of the observation direction vectors onto a globe of the January 2019 lunar eclipse (author: Jos Leys) 417

Figure 105 Photo of the full moon taken on October 22, 2010 in Madison, Alabama (USA), using a Celestron 9.25 Schmidt-Cassegrain telescope. Photo taken with a Canon EOS Rebel T1i camera (EOS 500D), by stacking 20 shots (ISO 200 1/640 sec) to reduce noise (author: Gregory H. Revera, source: Wikipedia) 420

Figure 106 Sun-Moon motion according to the flat-Earth hypothesis (illustration credit: Mark Garlick/Science Photo Library via Getty).....421

Figure 107 Artist's illustration of the phases of the Moon (copyright: Ryan Marciniak).....422

Figure 108 Sequence of the actual dynamics of tides.....438

Figure 109 14th century astrolabe, Spain (source: Aga Khan Museum).....440

Figure 110 AKM611, Astrolabe with different plates (source: Aga Khan Museum) 441

Figure 111 Navisphere (photos : Yann Lods, Objets de Marine, www.la-palmeraie.com) ..444

Figure 112 Globus INK 445

Figure 113 The Neptun-M IDS for the Soyuz-TM.....446

Figure 114 Polaris observation angle on a globe (source : FlatEart.ws/polaris-angle) 449

Figure 115 Actual Northern Hemisphere night sky.....452

Figure 116 Actual Southern Hemisphere night sky.....452

Figure 117 Night sky photos, northern vs. southern hemisphere (author: Tunc Tezel) 453

Figure 118 Déclinaison impossible sur la Terre plate (https://flatearth.ws/c/polaris).....462

Figure 119 Gegenschein at the Cerro Paranal Observatory (source: Wikipedia, author: ESO/Stéphane Guisard) 470

Figure 120 Meteor shower (source: NASA).....472

Figure 121 Illustration of surveyors/topographers with their cave dweller.....478

Figure 122 Some books for professional pilots that refer to a spherical Earth (credit: Wolfie6020) 494

Figure 123 Garmin G1000 Nxi.....500

translation into english ongoing

Figure 124 Map showing global cloud movement, September 2023 (source: NOAA / Science Photo Library) 542

Figure 125 Foucault's pendulum under the vault of the Pantheon in Paris (France) 554

Figure 126 Péndulo de Foucault, Costanera de la Ciencia. Valdivia, Chile (author : Alejandra Márquez) 556

Figure 127 Force diagram (author: Antoni Salvà, source: Wikipedia) 560

Figure 128 Illustration of the Sagnac effect (source : http://www.cleonis.nl/physics/phys256/sagnac.php) 562

Figure 129 Gyrolaser (source : Wikipedia) 563

Figure 130 Drawing of a homogeneously magnetized spherical magnet (source: Wikimedia, author: Geek.3) 568

Figure 131 The alignment of the iron filings confirms the shape of the calculated field lines (source: Popular Science Monthly Volume 83) 569

Figure 132 Magnetic field lines of a disk (source: VFPt flat cylinder magnet potential, by Geek3 and modified by Alyssa J. Pasquale, PhD, CC-BY-SA 4.0 license) 569

Figure 133 Magnetic field lines of Spherical Earth vs. Flat Earth (source : https://www.mezzacotta.net/100proofs/) 571

Figure 134 Southern aurora captured by NASA's IMAGE spacecraft in 2005 (credit: NASA/GSFC) 572

Figure 135 US Navy Over-the-Horizon Transferable Radar Station (December 10, 2001, author: US Navy) 573

Figure 136 LIGO interferometer at Caltech (Livingston, Washington, USA) 591

Figure 137 VIRGO interferometer (Pisa/Italy) 594

Figure 138 KAGRA underground interferometer (Kamioka/Japan) 596

Figure 139 Artist's rendering of the future Einstein telescope 598

Figure 140 Artist's rendering of the future Cosmic Explorer interferometer 600

Figure 141 Simplified artist's illustration of the merging of two Black Holes (source: LIGO/T. Pyle) 603

Figure 142 As black holes spiral closer together, the frequency of their gravitational waves increases. (image credit: LIGO, February 11, 2016) 604

Figure 143 Photo of part of the SPS tunnel (source: CERN) 605

Figure 144 Photo of the LHC tunnel (source: CERN) 607

translation into english ongoing

Figure 145 Aerial photo of the SLAC in Stanford, USA.....609

Figure 146 KEK Japan Accelerator in Tsukuba, Japan 613

Figure 147 Photo from the Relativistic Heavy Ion Collider (RHIC).....615

Figure 148 The linear accelerator brings the electrons up to the final energy required (source: PSI/Markus Fischer) 617

Figure 149 ECDIS900 MK5A 624

Figure 150 Furuno 3000 Series ECDIS 624

Figure 151 MINOS detector at Fermilab 633

Figure 152 South Pole Highway (source : Wikipedia) 655

Figure 153 Screenshot from Wikipedia, August 2026, on the page about the shape of the Earth 694

Figure 154 Globe in a school classroom (Sierra Leone, January 2015 credit: GPE/Stephan Bachenheimer) 695

Figure 155 A photo taken on June 3, 2019 shows models and structures on astronomy and galaxies inside the Clock Tower Museum in the Saudi holy city of Mecca (credit: Agence France Presse).....695

Figure 156 Globe of Martin Behaim (photo taken on March 31, 2006 by Alexander Franke, source: Wikipedia).....696

Figure 157 Photoshop of the announcement that the members of the Flat Earth Society have members around the globe.....704

Figure 158Étendue de l'empire mongol a son paroxysme au 13e siècle (source : Wikipédia) 705

Figure 159 A celestial globe in gold and silver by the Muslim Muhammad ibn Muy-ayyad al-'Urdi Iran, 1297 (Mathematisch-Physikalisher Salon, Staatliche Kunstsammlungen (E II 1), Dresde).....706

Figure 160 Marco d'Oggiono, Salvator Mundi (year 1500), Galerie Borghèse, Roma (Italy) 710

Figure 161 Circle of Vinci, The Savior of the World, circa 1505; Museum of Fine Arts of Nancy (France).....711

Figure 162 Salai, Cristo giovanetto come Salvator Mundi, Museo Ideale Leonardo da Vinci, Vinci before 1524 (Italy) 711

Figure 163 Giampietrino, Salvator Mundi, befpre 1550,Pouchkine, Moscow museum (Russia) 712

translation into english ongoing

Figure 164 Qibla direction on a flat Earth vs. a spherical Earth (source: FlatEarth.ws) 728

Figure 165 Vatican Observatory on the heights of Castel Gandolfo 732

translation into english ongoing

CHANGE LOG (for major versions only)

Here we detail the various updates to this booklet since its first major version (i.e., version 1.0):

- ….

translation into english ongoing

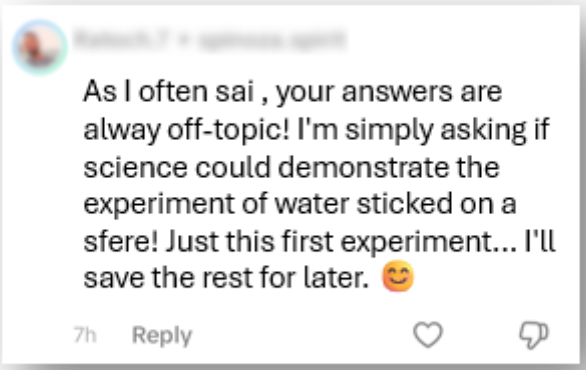
translation into english ongoing

ADDENDUM

We put here some points which are not directly related to proofs/evidence of the sphericity/curvature of the Earth but which proponents of the flat Earth like to push forward in a false and fallacious way.

(#A01) Making water stick on a ball

Let's take, for example, the following pseudo-challenge from a flurfler on TikTok (note in passing the level of spelling and grammar, which speaks a lot about their level of education):


As I often sai , your answers are alway off-topic! I'm simply asking if science could demonstrate the experiment of water sticked on a sfere! Just this first experiment... I'll save the rest for later. 😊
7h
Reply

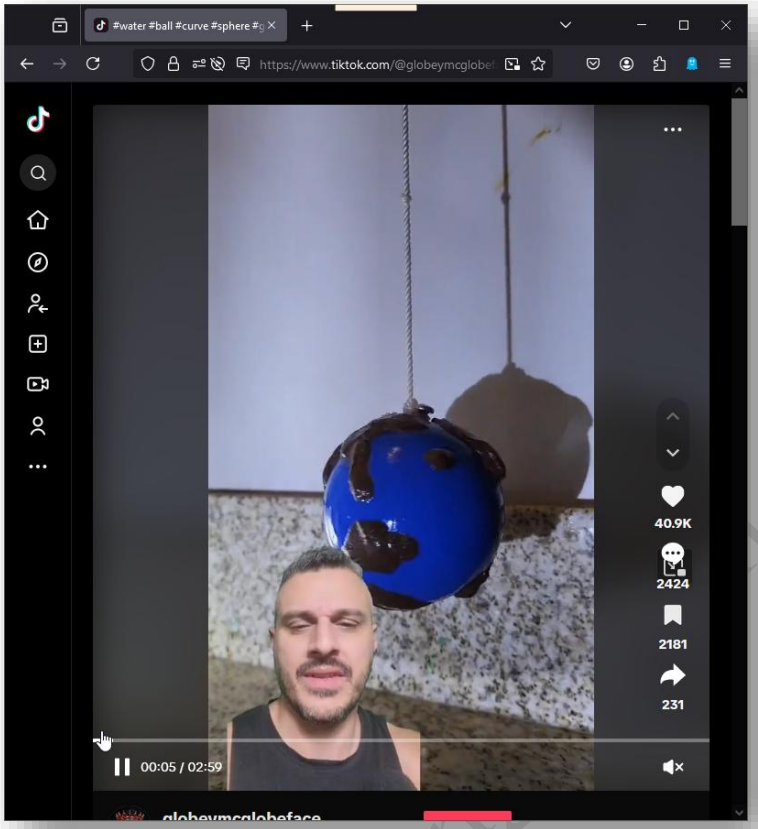
When flurfers (…) tell you that water cannot stay on a sphere, show them this!

En comparaison avec la taille de la Terre, il y a un volume d'eau sur cette boule bleue visible dans la vidéo ci-dessous, plus important que le volume des océans. Effectivement, la Terre a un rayon d'environ 6 378 km et la partie de l'océan la plus profonde fait 10 997 km. Donc l'épaisseur des océans fait 0.1724 % du rayon de la Terre !

Et lorsqu'ils vous demanderont de faire tourner cette boule à la vitesse de 1667 km/h, faites tourner la boule à raison de 1 tour en 24h et elle aura la même vitesse angulaire que la terre. Et à cette vitesse, toutes les gouttes d'eau tiendront sans problème.

Une vidéo une autre sphère avec une petite reproduction grossière des continents et en plus avec la sphère qui tourne est ici disponible sur TikTok :

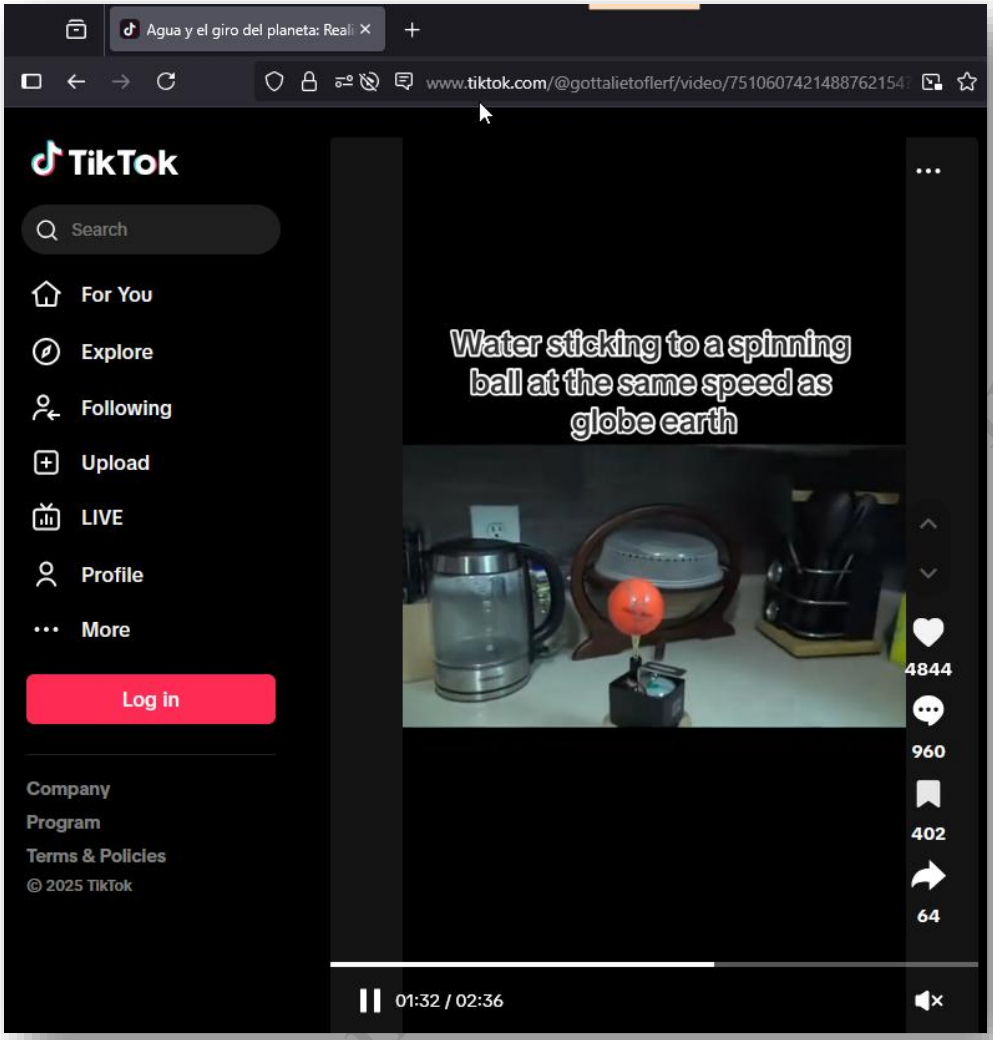
https://www.tiktok.com/@globeymcglobeface/video/7161213797867375918?_r=1&_t=8ruhLT5NPvi



Il y a aussi une vidéo du même genre ici :

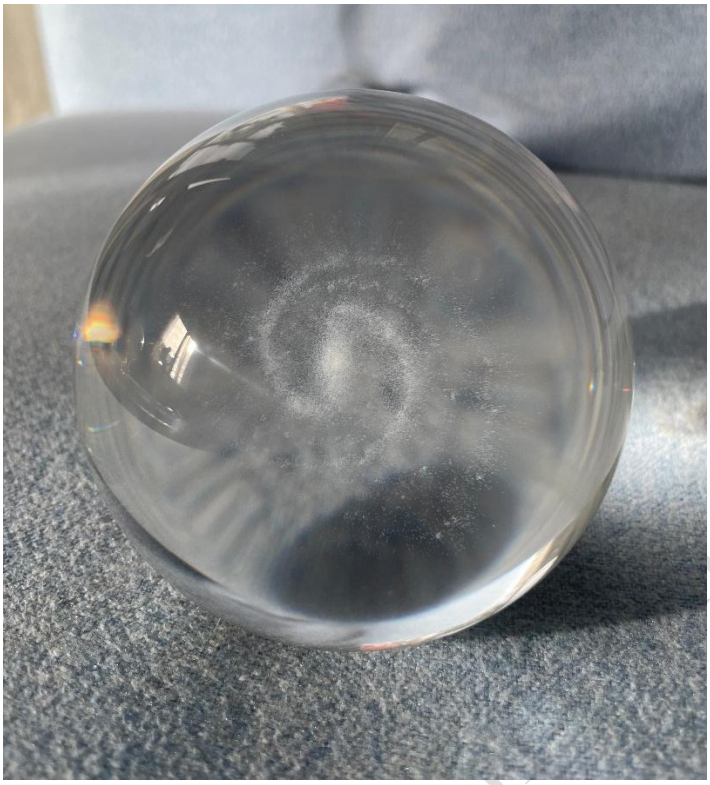
https://www.tiktok.com/@gottalietoflerf/video/7510607421488762154?_t=ZN-8wsUIavddH4&_r=1

translation into en ongoing

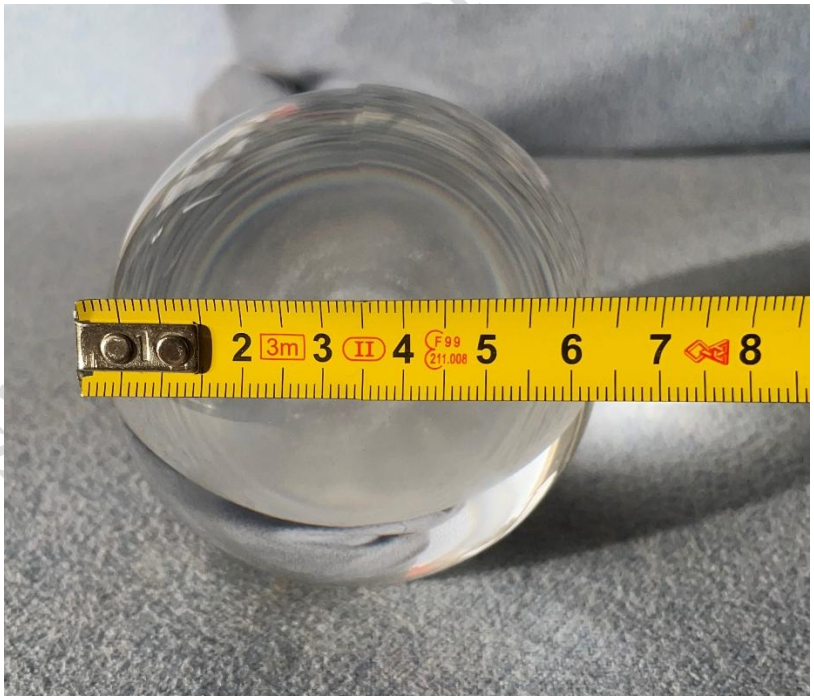


Comment reproduire chez vous de l'eau qui tient sur une sphère ? Prenez une boule quelconque comme par exemple (boule achetée ici https://www.cinks-labs.de) :

translation in progress



Nous avons :



Une mesure plus précise qu'avec un mètre donne un rayon de 4 cm. Et voici le spécifications données sur le site web de vent :

SPECIFICATIONS

General	
Diameter (mm)	80
Material	Glass
Weight (g)	660
Series	Sphere

Donc en comparaison avec la Terre, faire tenir 0.06 millimètres d'eau sur cette boule est une preuve que l'eau qui reste statique sur une surface a courbure positive est possible.

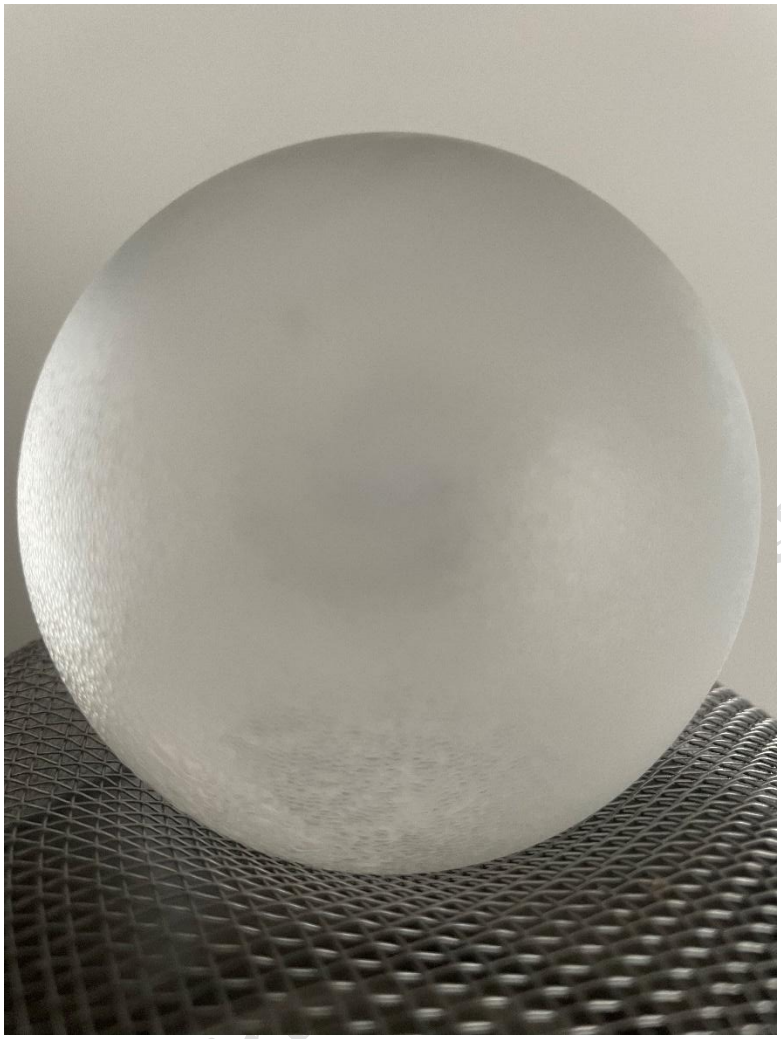
Notez que l'œil humain ne peut pas voir ce qui est plus petit que 0.1 mm long, donc si nous voyons de l'eau autour de notre boule c'est que nous avons forcément plus de 0.1 mm et donc plus que 0.06 mm !

Pour le reste de l'expérience vous aurez besoin d'une casserole, de la boule en question et d'une passoire :

Ensuite on place le tout sur une cuisinière avec environ un demi-litre d'eau du robinet au fond de la casserole que l'on place ainsi afin de minimiser le contact de la boule avec la passoire :

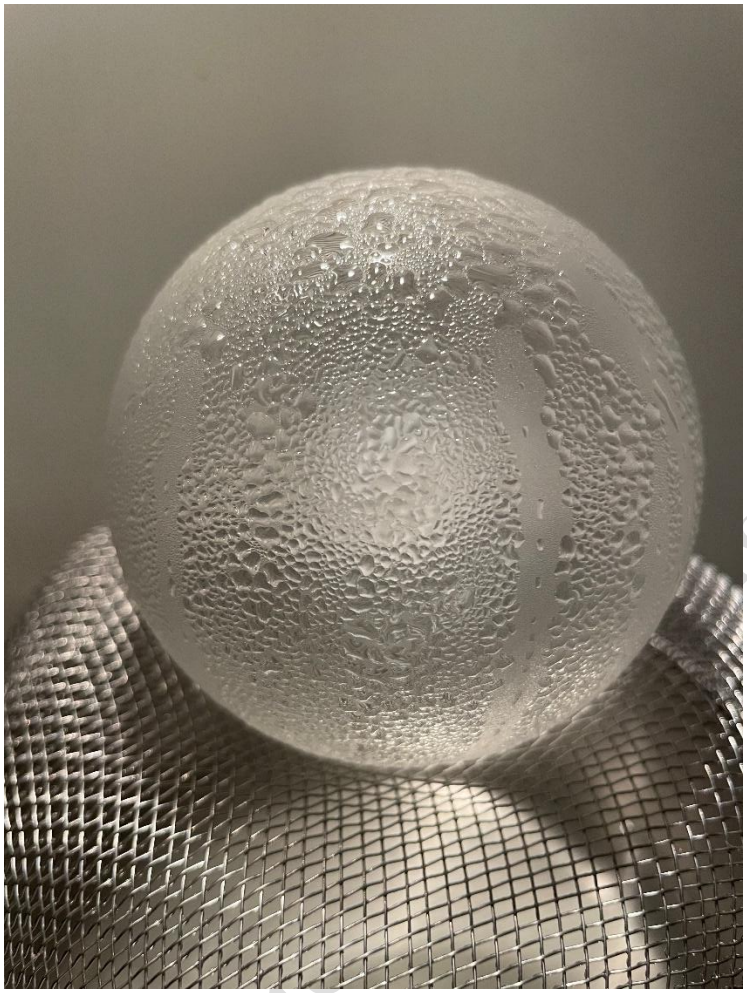
On fait bouillir l'eau et après 5 minutes on coupe le feu de la plaque de cuisine et on observe alors que l'eau se maintient bien sur la boule comme le demandent les platistes et ce même dans la partie inférieure comme cela est clairement visible sur la photo ci-dessous :

translation into english ongoing



Si on laisse l'évaporation plus longtemps, nous avons la formation de grosses gouttes qui elles aussi tiennent sur la surface à courbure positive de la sphère :

translation in progress



Donc voilà la preuve comme quoi on peut fait tenir de l'eau sur une boule les flatulistes… passez votre chemin !

translation in progress

(#A02) 24-Hour Earth Video

Rappelons d'abord la définition du mot « vidéo » selon l'académie française :

https://dictionnaire-academie.fr/article/A9V0750

I.

I. Nom féminin.

1. Ensemble des techniques électroniques permettant l'enregistrement, le traitement, la transmission et la visualisation d'images animées accompagnées de son ; matériel, appareil qui utilise ces techniques. *Vidéo analogique, numérique. Vidéo à haute définition. Tourner un film, un reportage en vidéo. Le recours à la vidéo dans l'arbitrage d'un match. Une vidéo légère.*

2. Document audiovisuel enregistré sur un support électronique (on dit aussi parfois *Vidéogramme*). *Regarder une vidéo. Des vidéos en ligne.*

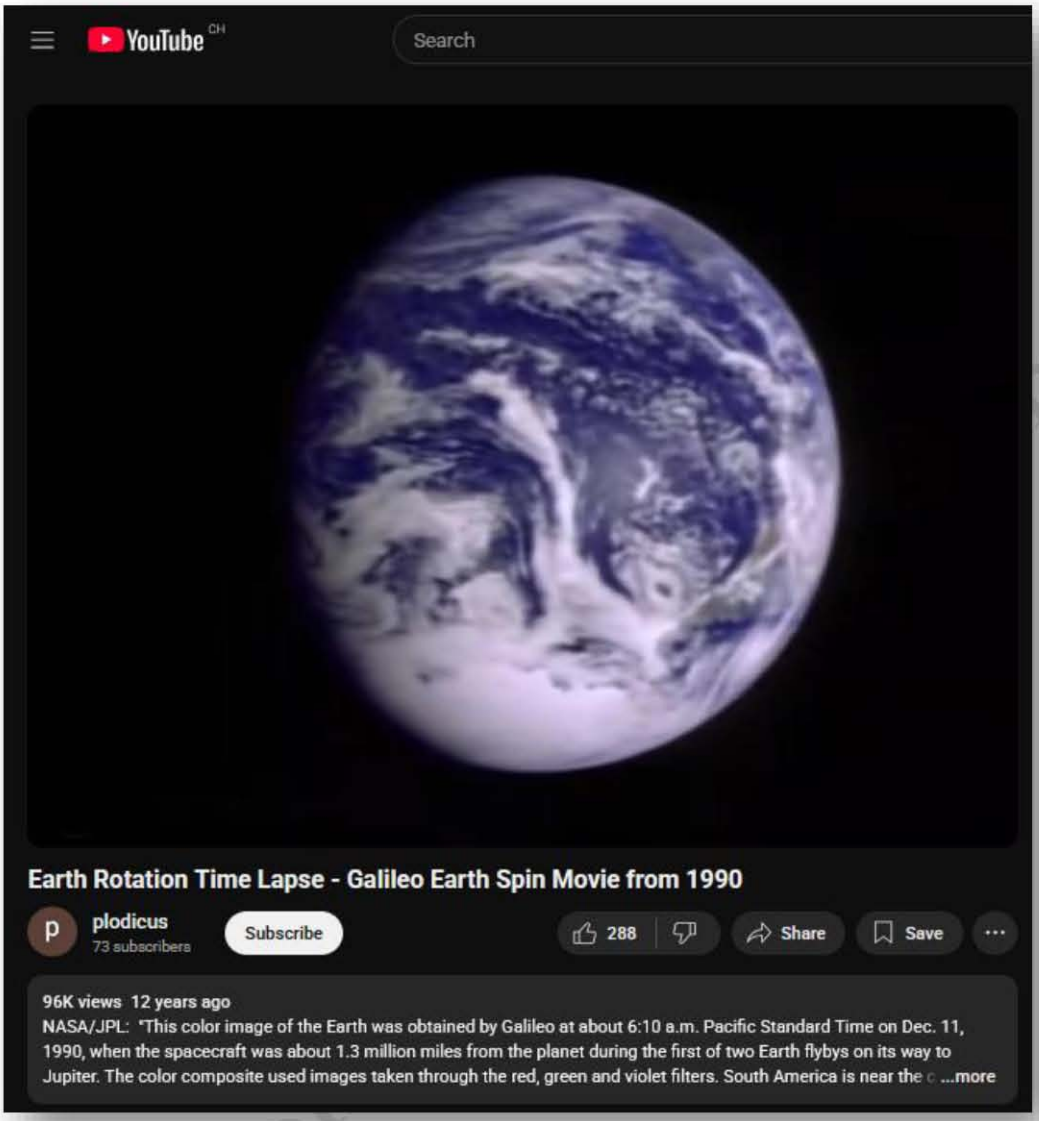
▪ Loc. *Service de vidéo à la demande* ou, elliptiquement, *vidéo à la demande* ou, par abréviation, *V.A.D.*, service de diffusion de documents audiovisuels, notamment de films, auquel le spectateur peut accéder à tout moment à partir d'un téléviseur, d'un ordinateur, etc.

Et oui cela existe pour la Terre ! Voici la vidéo en images couleur de la Terre a été obtenue par Galileo vers 6 h 10, heure normale du Pacifique, le 11 décembre 1990, alors que la sonde se trouvait à environ 2.1 millions de kilomètres de la planète lors du premier de ses deux survols en route vers Jupiter. La composition couleur utilise des images prises à travers les filtres rouge, vert et violet. L'Amérique du Sud est située près du centre de l'image, et le continent blanc et enSoleillé de l'Antarctique est en dessous. De pittoresques fronts météorologiques sont visibles dans l'Atlantique Sud, en bas à droite. Il s'agit de la première image du film Galileo sur la rotation de la Terre, un film accéléré de 500 images montrant une période de 25 heures de la rotation de la Terre et de la dynamique atmosphérique (crédit image : NASA/JPL).

Et voici le lien (si vous observez-bien on y voir les nuages bouger et fusionner) :

https://www.youtube.com/watch?v=ceJOBFj3hKs

translation into eng


YouTube CH
Search
Earth Rotation Time Lapse - Galileo Earth Spin Movie from 1990
plodicus
73 subscribers
Subscribe
288
Share
Save
96K views 12 years ago
NASA/JPL: "This color image of the Earth was obtained by Galileo at about 6:10 a.m. Pacific Standard Time on Dec. 11, 1990, when the spacecraft was about 1.3 million miles from the planet during the first of two Earth flybys on its way to Jupiter. The color composite used images taken through the red, green and violet filters. South America is near the c ...more

translation pending

ERRATUM

A document/textbook without errors is the exception rather than the rule. We will communicate here all the errors from previous versions in detail because we too are human and sometimes make mistakes...

If you have any errors to report or wish to provide additional "proofs", you can contact us via the following email address:

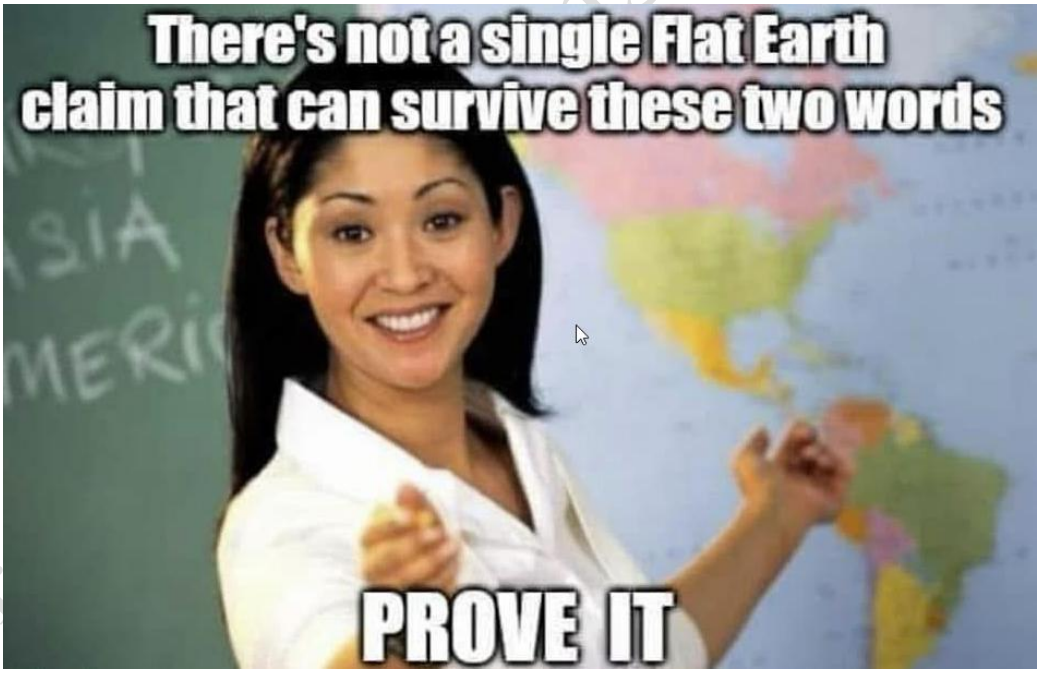
globus.telluris@protonmail.com

Obviously, we will also include here the retracted “proofs” if the flat-Earthers manage to refute them scientifically (scientific publication in a peer-reviewed journal with an Impact Factor greater than 10), but that is unlikely to happen…

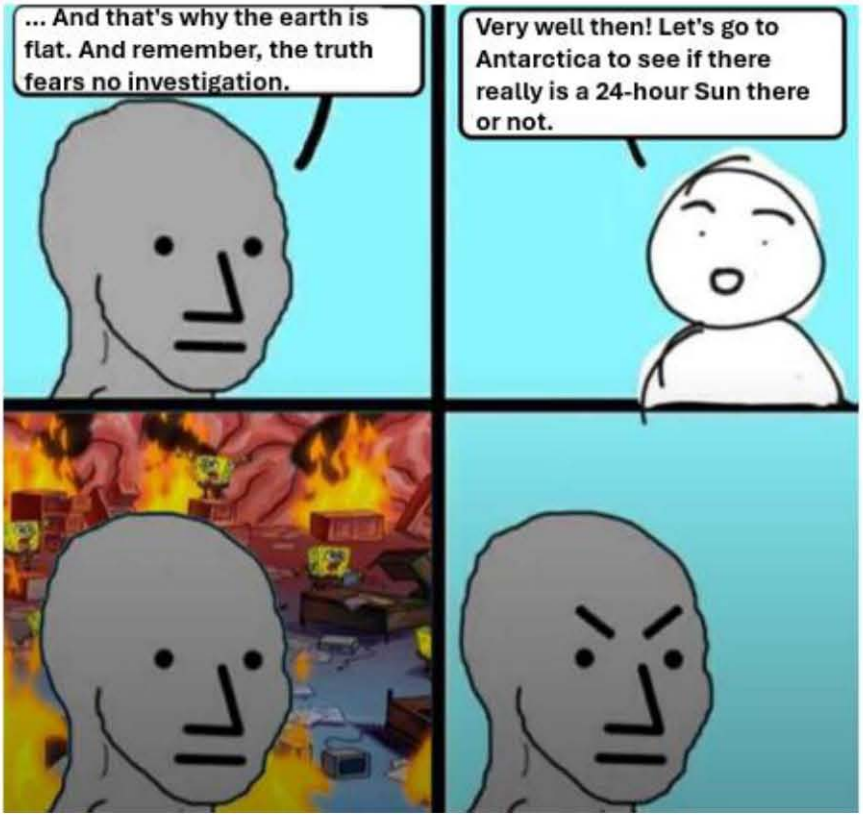
translation into english ongoing

HUMOR

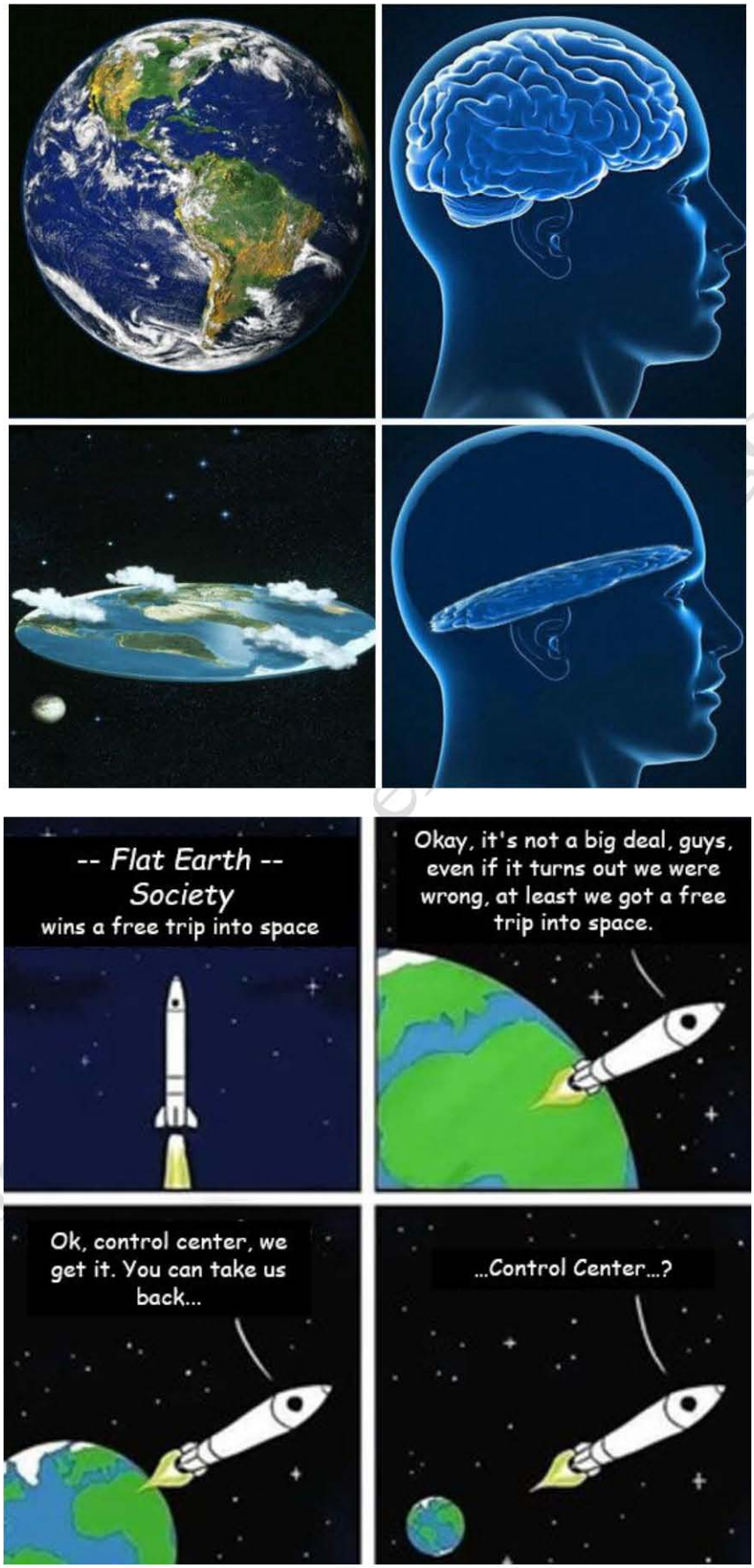
Because ending on a humorous note can never hurt (if you've survived the fits of laughter this far while reading the absurd and unrealistic arguments of flat Earth believers…), here's a small collection of about 90 memes…:



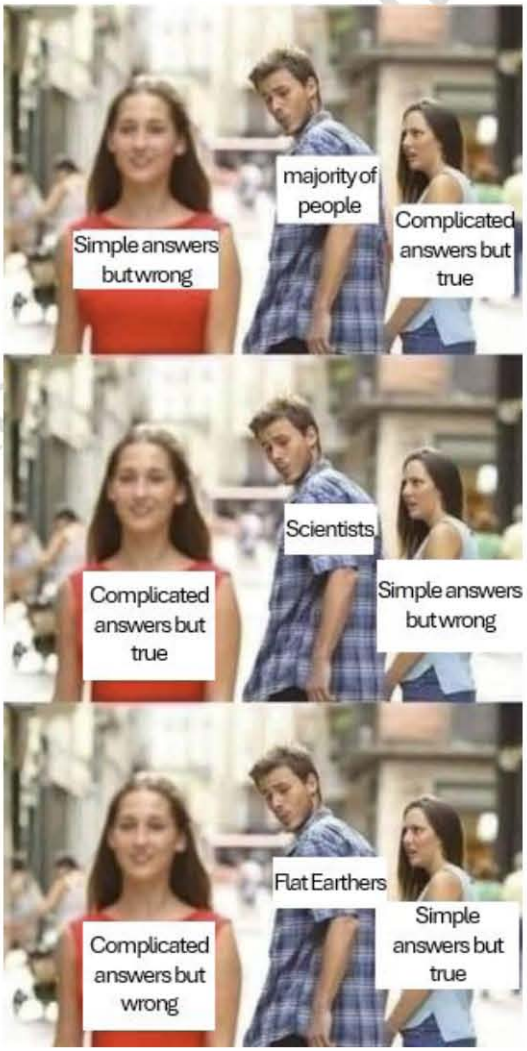
This is what flat-Earthers' see when the weather conditions are good


... And that's why the earth is flat. And remember, the truth fears no investigation.
Very well then! Let's go to Antarctica to see if there really is a 24-hour Sun there or not.

translation into ...ing

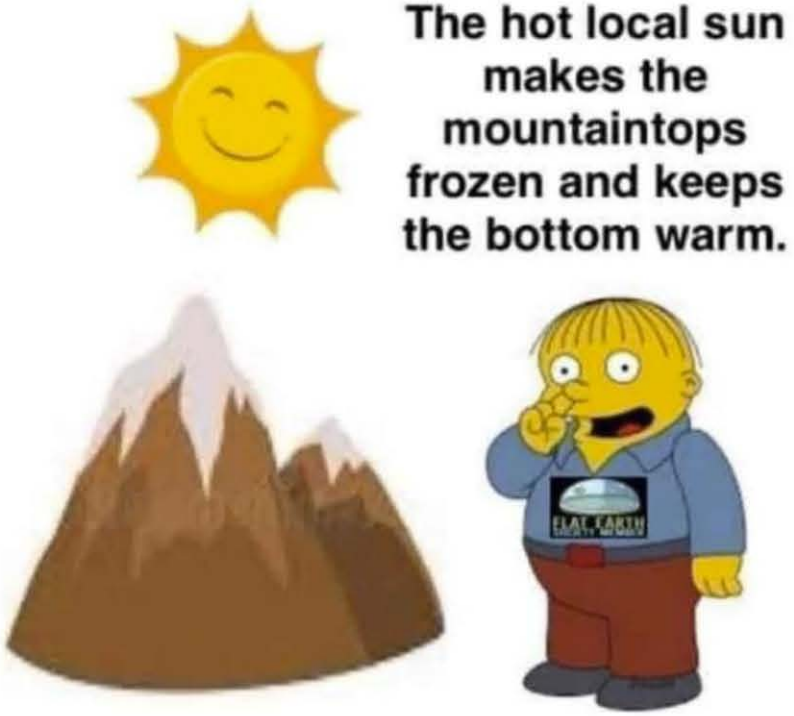

-- Flat Earth --
Society
wins a free trip into space
Okay, it's not a big deal, guys, even if it turns out we were wrong, at least we got a free trip into space.
Ok, control center, we get it. You can take us back...
...Control Center...?

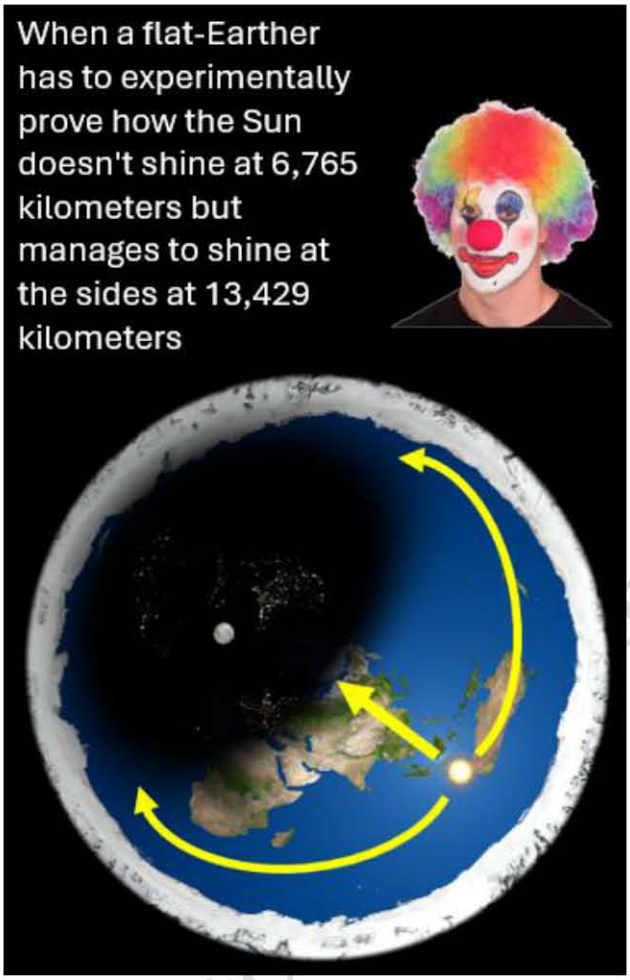
FLAT-EARTHERS
How neighbors see me
How my father see me
How my mother see me
How the society see me
How i imagine myself
How i am in reality



translation in progress

I can't see the large sun at night but I can see the tiny stars behind the sun because of perspective.


The hot local sun makes the mountaintops frozen and keeps the bottom warm.


When a flat-Earther has to experimentally prove how the Sun doesn't shine at 6,765 kilometers but manages to shine at the sides at 13,429 kilometers

translation into ongoing

Astrophysics scientist

Flat-Earth scientist

Claim that the Earth is flat and that it is at the center of the whole Universe

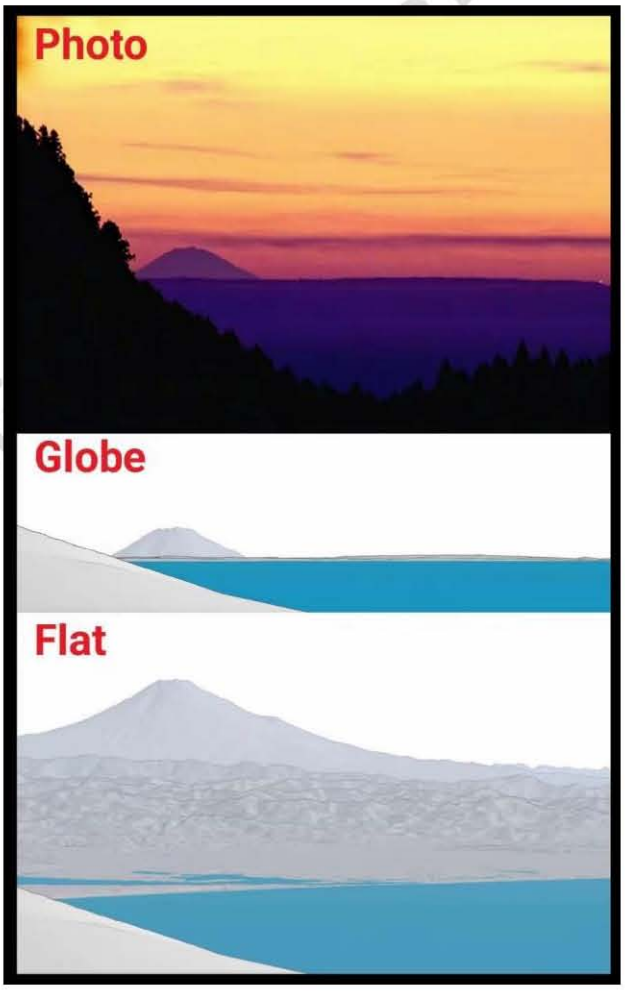
Justifying yourself by showing a phenomenon independent of the shape of the Earth

Attempting to discredit the current scientific theory with examples that neglect the majority of physical phenomena

Accusing the whole world of being believers and sheep to convince themselves that they are unique and the sole possessors of the truth

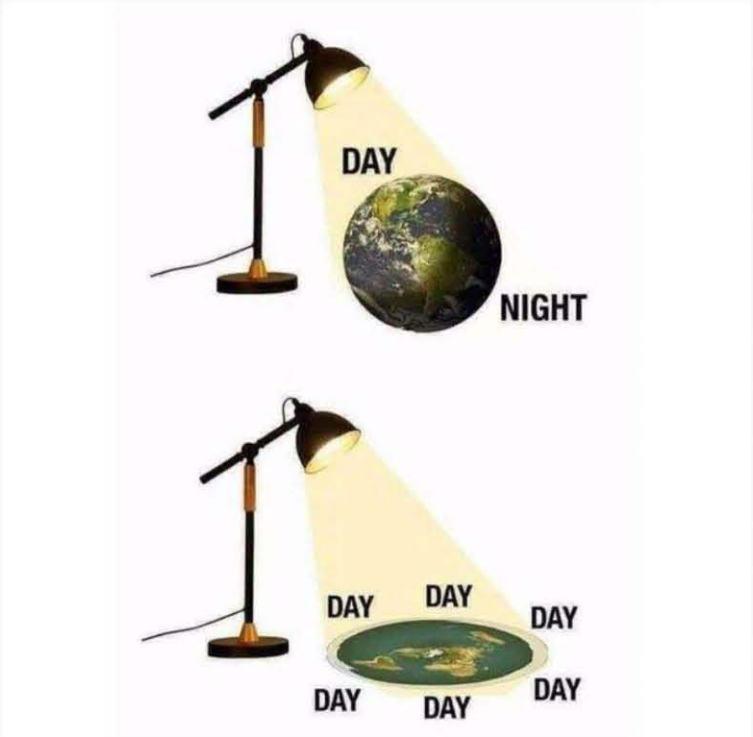
THE FLURFER PLATFORMER'S BINGO		
Sheep!	**All the information are on Odysee**	**Stay in your Disney world**
Go back look CNN	**Who benefits from the crime?**	**Wake up!**
Coincidence	**Do your own research**	**The Truth is painful**
You are paid by the government	**You are paid by the Zionists**	**You are being manipulated by Satan**
You cannot prove that water sticks on a ball	**You cannot store a gas in an unsealed container**	**The laws of perspective are not those taught in school**
Calculations don't prove anything	**How many times have you been stung?**	**You can make numbers say whatever you want**

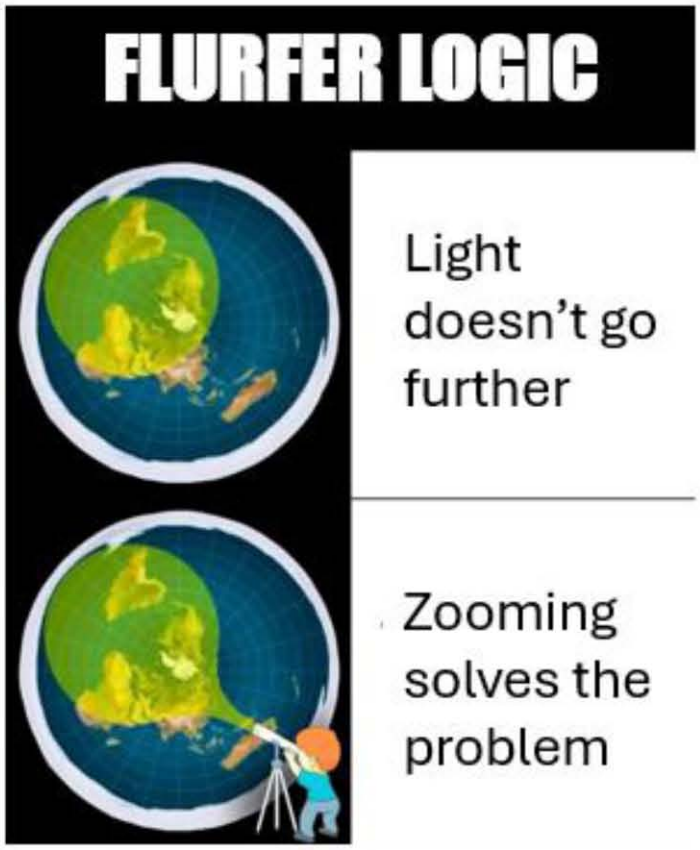
translation into englis

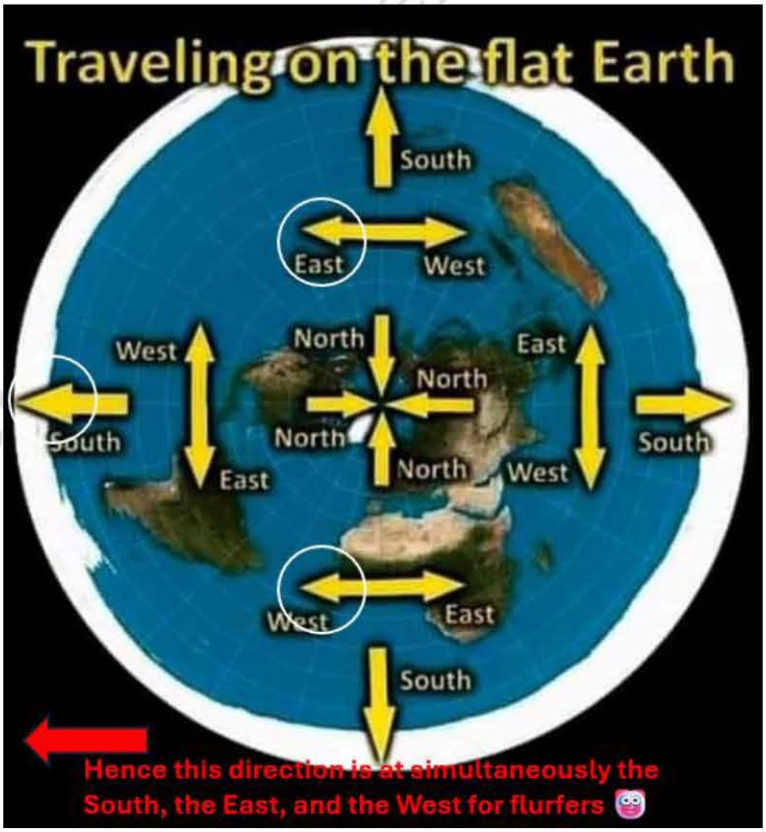


translation in progress

Just putting this out there for the flat earthers




FLURFER LOGIC
Light doesn't go further
Zooming solves the problem


Traveling on the flat Earth
South
East
West
North
West
East
North
South
North
South
East
North
West
West
East
South
Hence this direction is at simultaneously the South, the East, and the West for flurfers

translation into going

Flat-Earthers, when they realize they are breathing air from the atmosphere, and not from the atmodisc

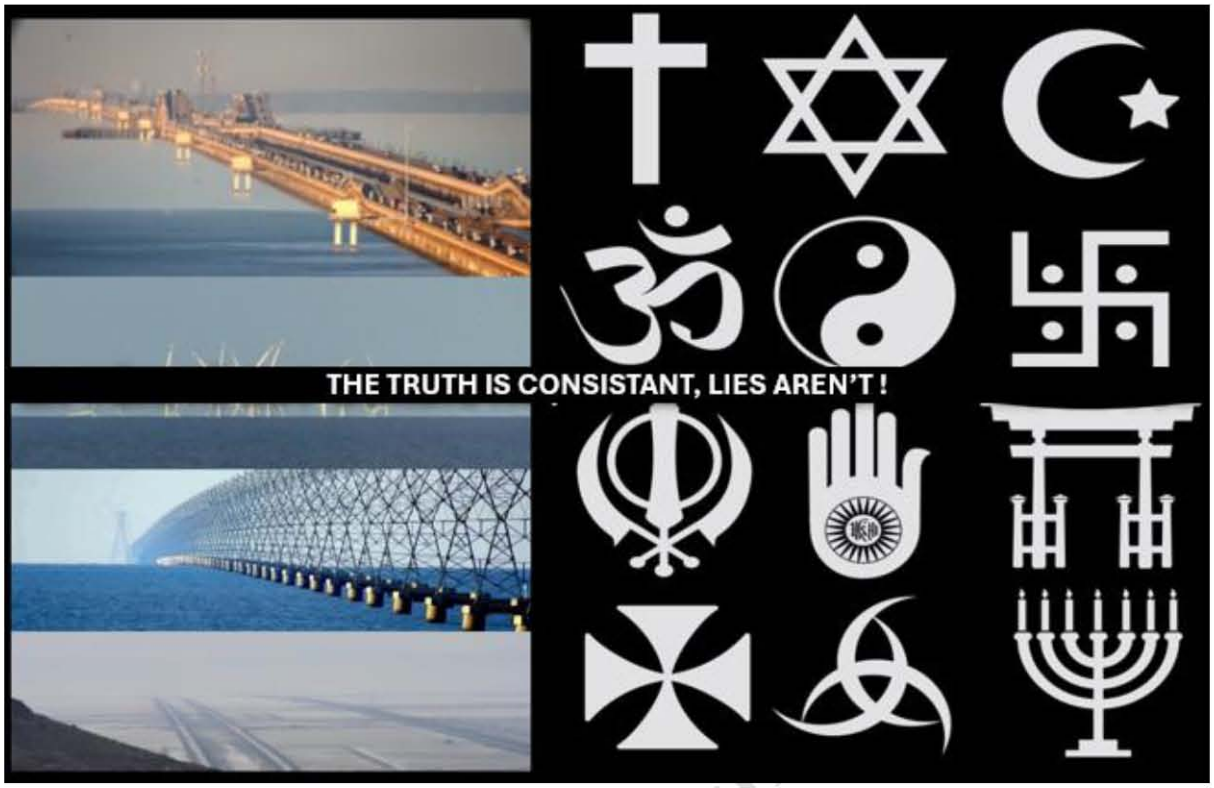
American flat-Earthers spent approximately $20,000 trying to prove that the Earth is flat, only to ultimately prove that it is actually spherical.

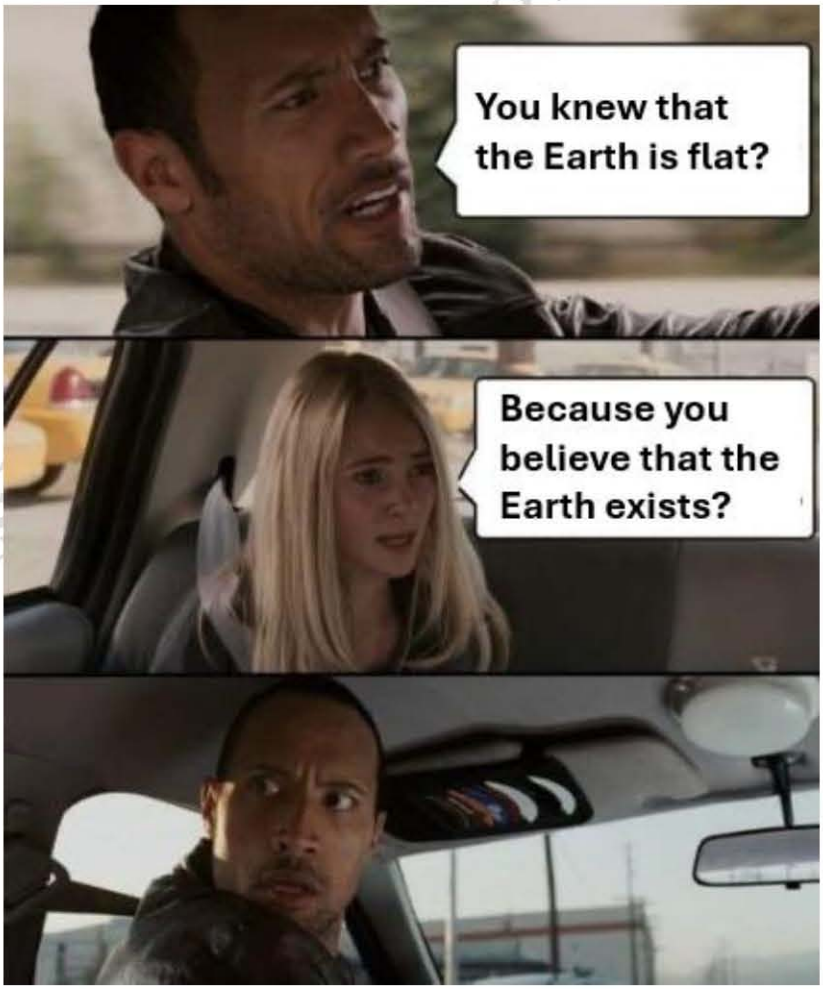
ME:

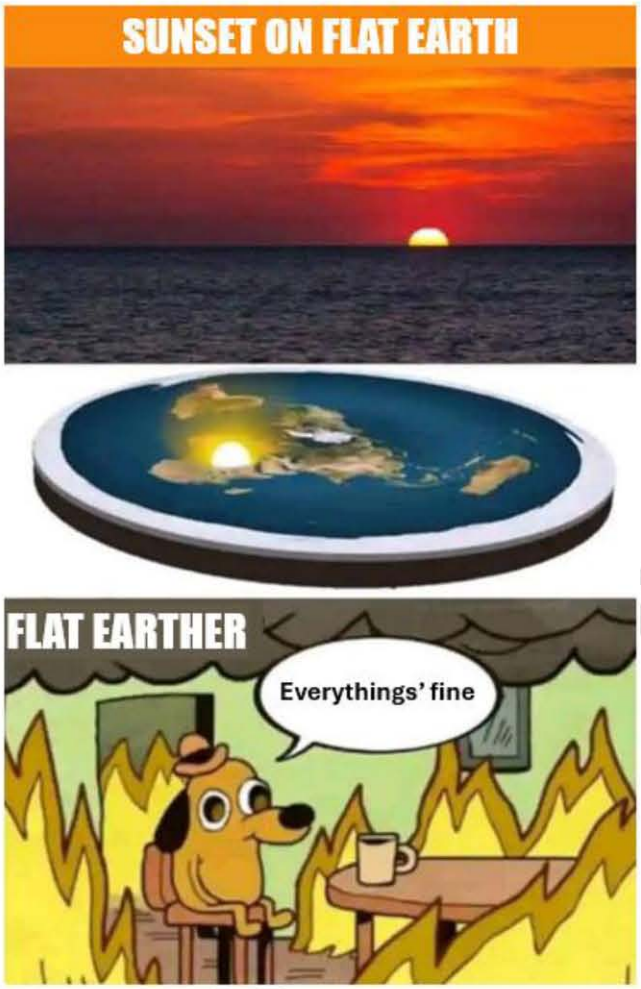
SEE THE EARTH IS CURVED

FLURFERS:

SEE THE EARTH IS FLAT

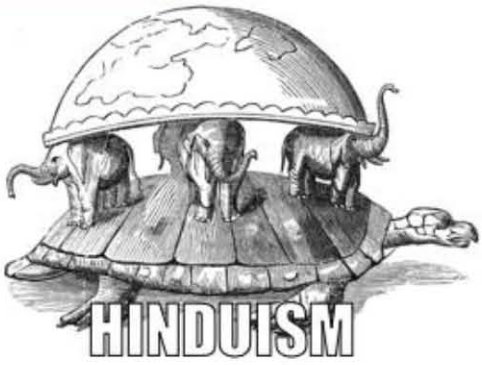

THE TRUTH IS CONSISTANT, LIES AREN'T !


You knew that the Earth is flat?
Because you believe that the Earth exists?


SUNSET ON FLAT EARTH
FLAT EARTHER
Everythings' fine

WHEN YOU ARE IN THE MUSEUM OF SCIENTIFIC DISCOVERIES AND INVENTIONS OF THE FLAT EARTHERS

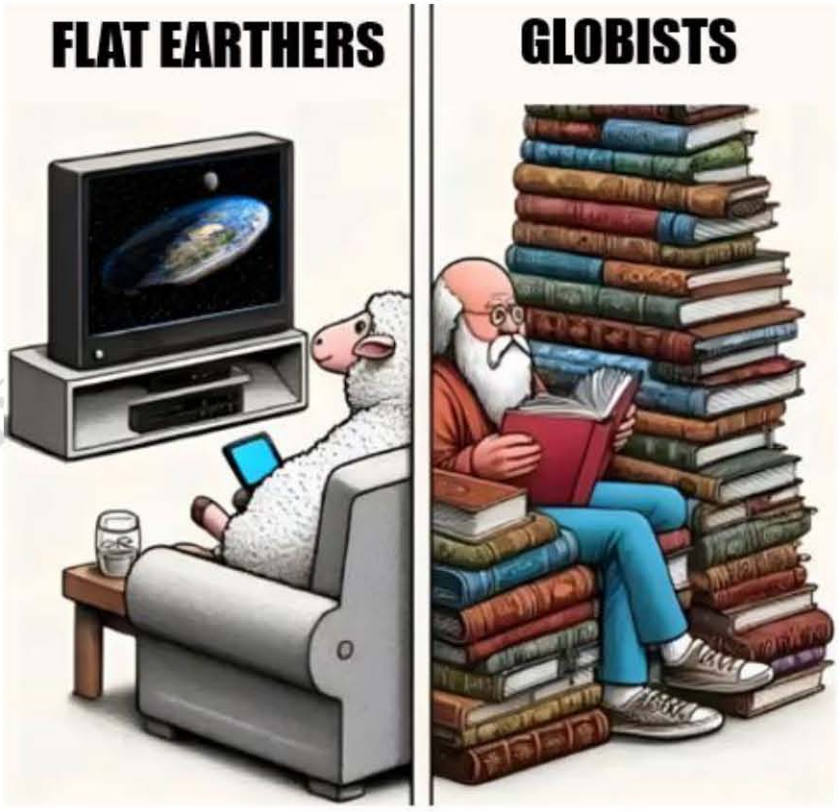
THREE DIFFERENT MONOTHEISTIC RELIGIONS



THREE COMPLETELY DIFFERENT WORLDS.
YOUR DELUSIONS DOESN'T HAVE ANY VALUE FOR ME!

translation
going

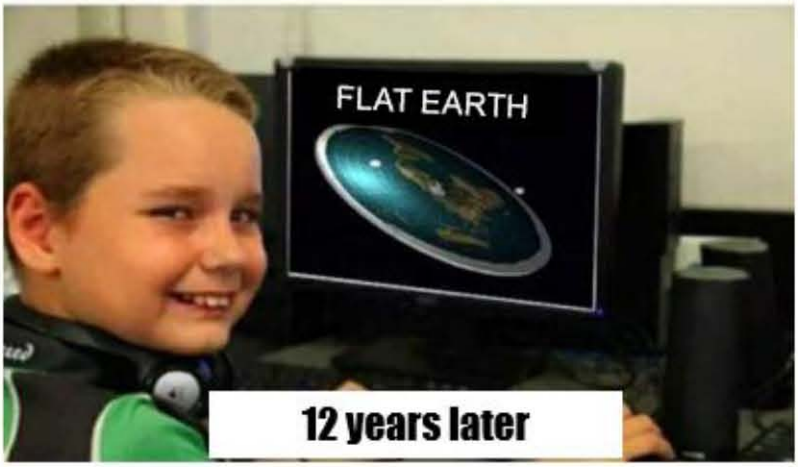
FLAT EARTHER LIE
SCIENTIFIC TRUTH


FLAT EARTHERS
GLOBISTS

RELIGIONS
FLAT EARTHERS

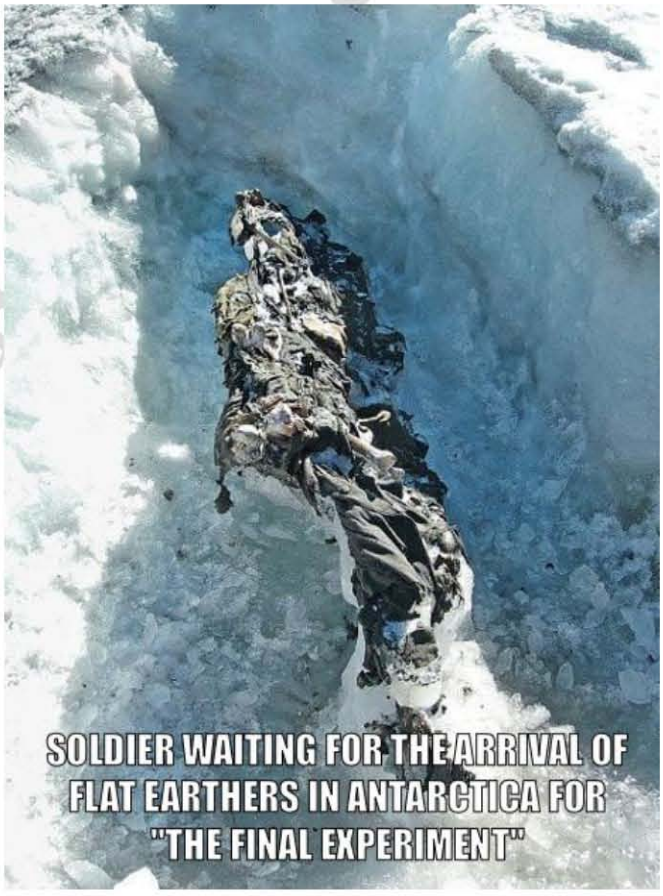
Disney PIXAR
FLAT EARTH

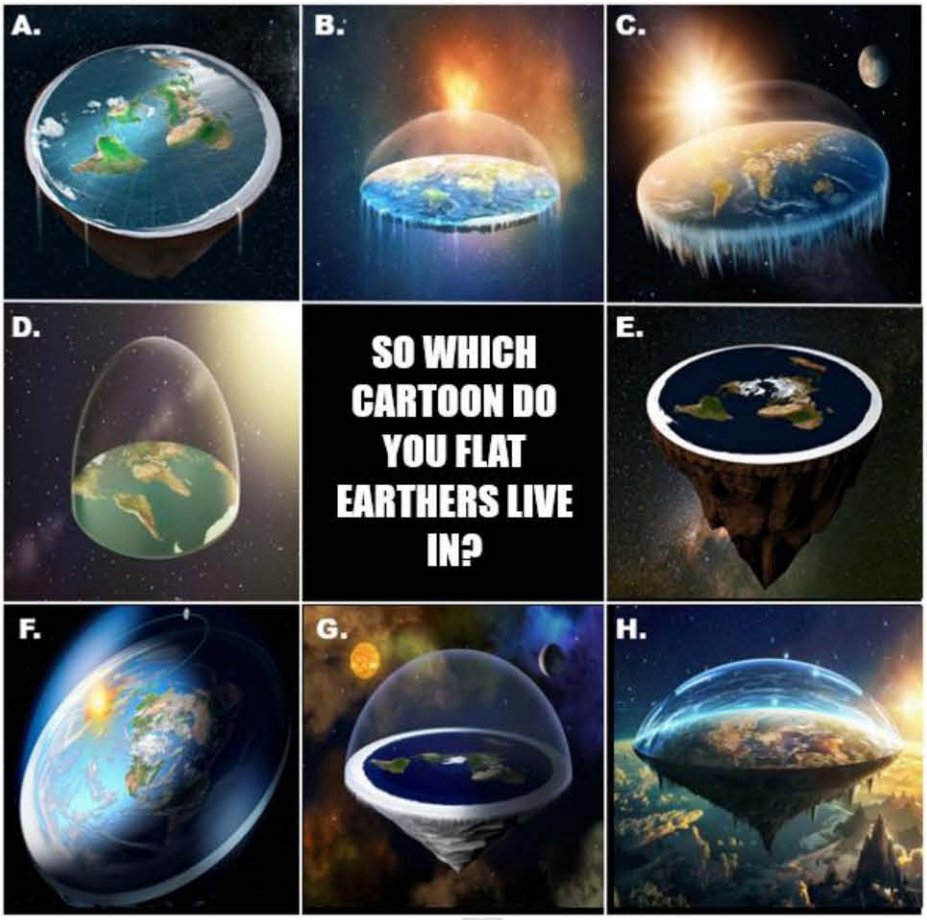
No, this doesn't affect my baby

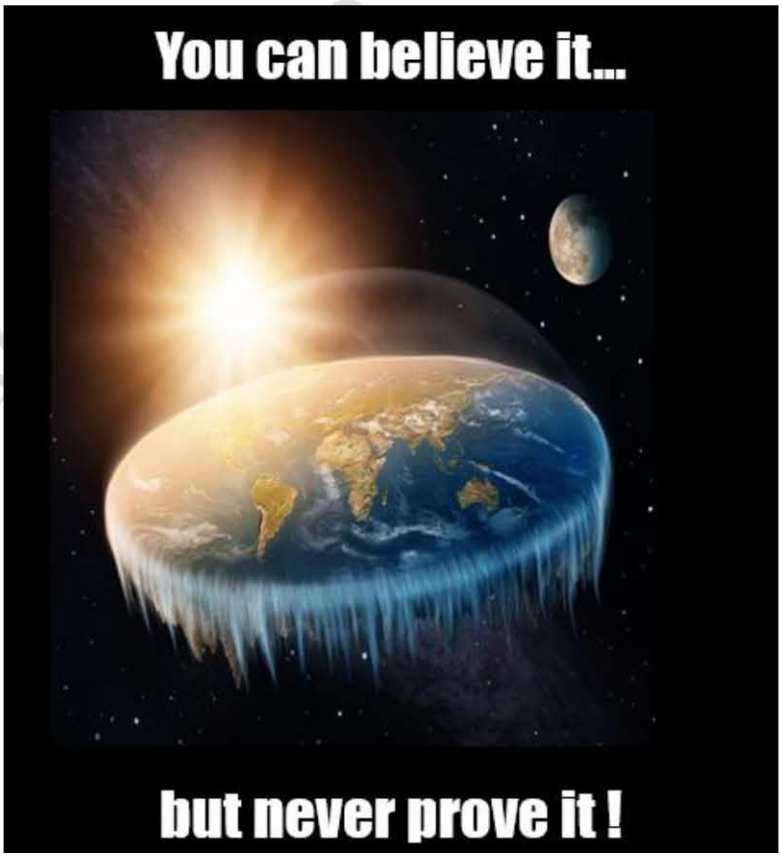

FLAT EARTH
12 years later

PROOF THAT A BASKETBALL IS FLAT ACCORDING TO FLAT EARTHERS!

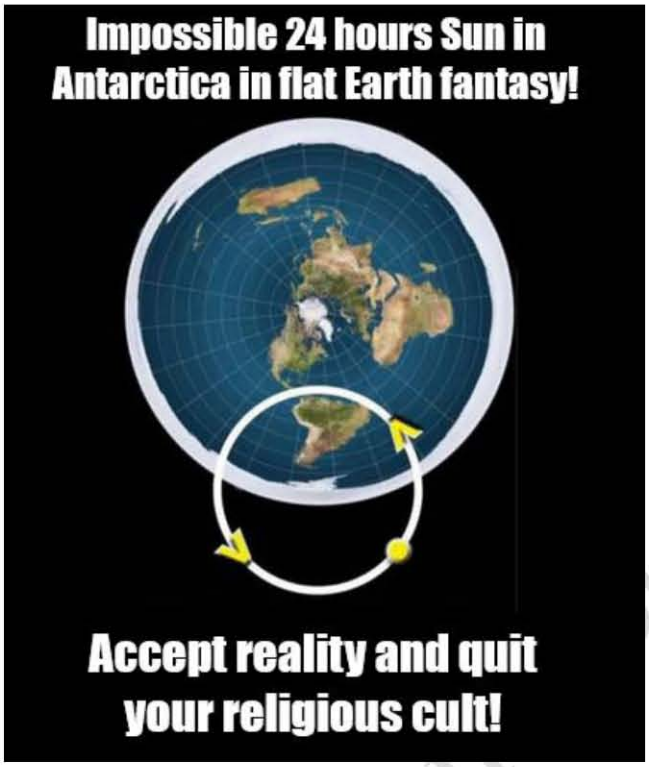
THE FLAT EARTH
* Described in cult books dating back 1400 years and more
* Confined under a dome
* Allows them to keep believers under control and extract their money (>2 trillion/year)
* Allows them to hide the fact that the universe is larger and that there are other planets
* Make you believe you are made from clay/dust
* Take away your freedom to better manipulate you
* Keeps you in ignorance
THE GLOBE EARTH
* At the foundations of science, technology, and modern comfort
* Scientifically proven
* Scientists have no reason to lie
* Most scientists receive no monetary compensation
* Opens your eyes to charlatans and manipulators
* Develops critical thinking
You see why Flat earthers lie?


SOLDIER WAITING FOR THE ARRIVAL OF FLAT EARTHERS IN ANTARCTICA FOR "THE FINAL EXPERIMENT"

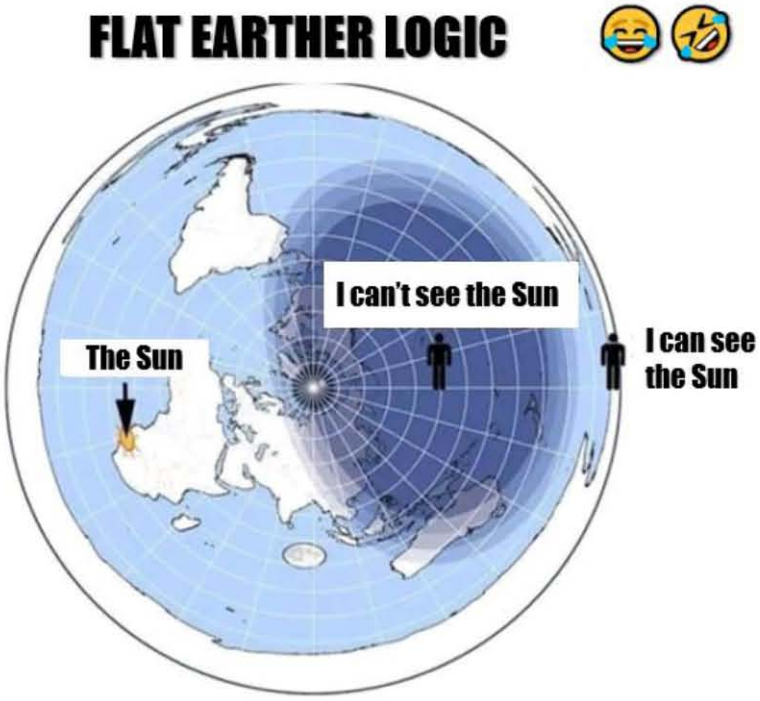

A.
B.
C.
D.
SO WHICH CARTOON DO YOU FLAT EARTHERS LIVE IN?
E.
F.
G.
H.


You can believe it...
but never prove it !

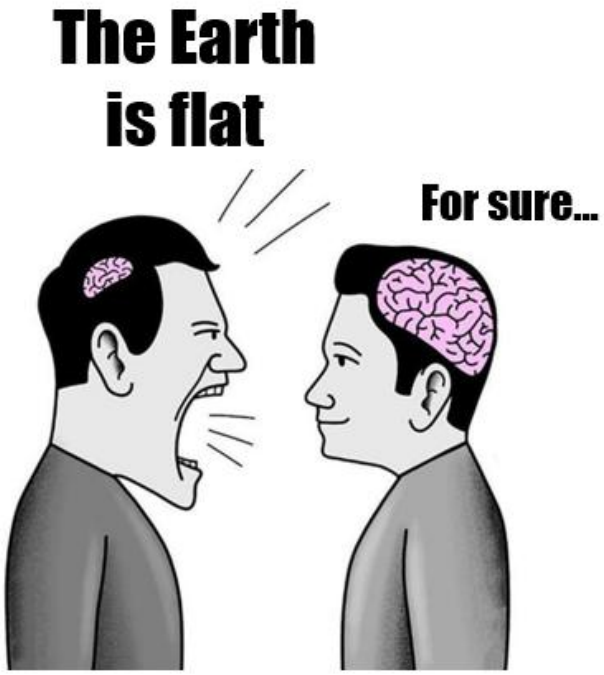
translation ongoing


Impossible 24 hours Sun in Antarctica in flat Earth fantasy!
Accept reality and quit your religious cult!

FLAT EARTH MAP
FLY PATH DOESN'T MAKE ANY SENS
EARTH GLOBE
FLY PATH MAKES TOTALLY SENSE

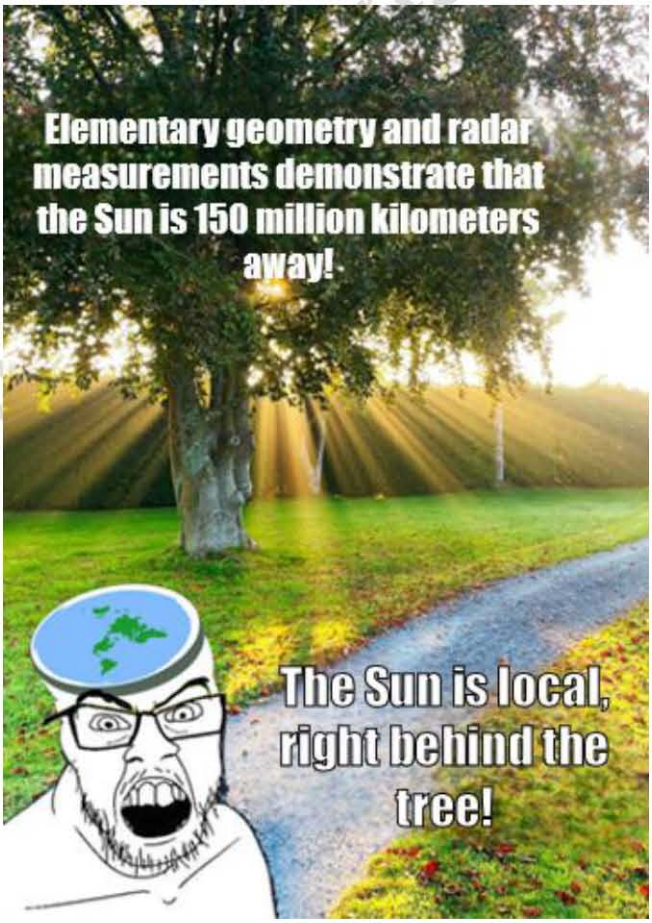

FLAT EARTHER LOGIC
I can't see the Sun
The Sun
I can see the Sun

While flat-Earthers show us only cartoons of their flat Earth for the last 6000 years...
We show them real, original, non-composite photos !

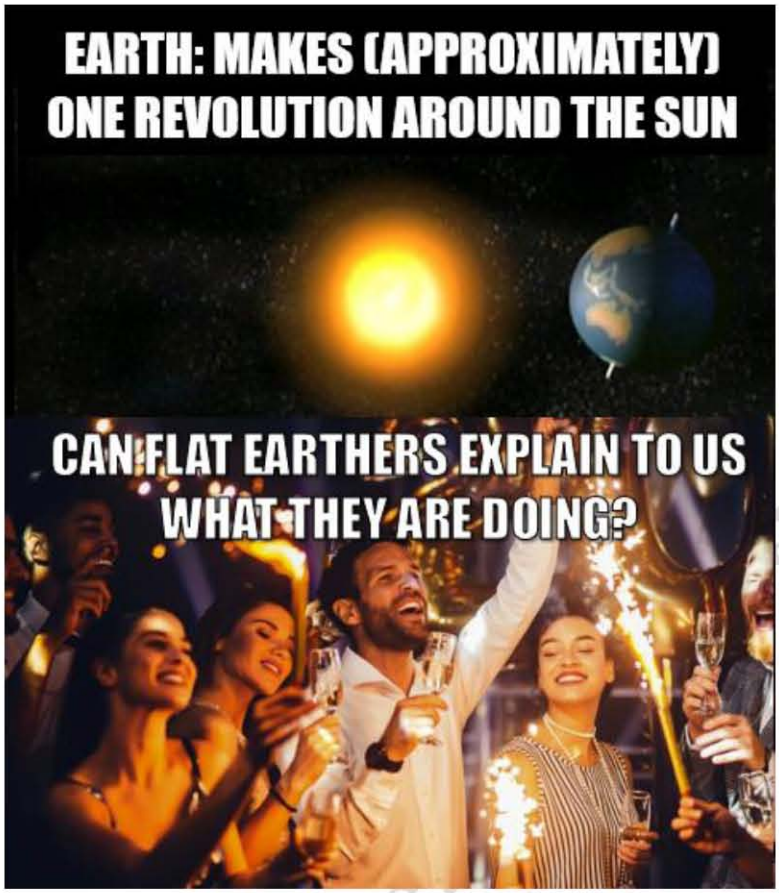


What the Flat Earth proponents have produced	
Proof of flateness	❌
Proof of immobility	❌
Proof of the Local Sun	❌
Proof of the local moon	❌
Proof of the non-existence of gravity	❌
Hypotheses & Opinions	✅
Repeating like wild parrots of their indoctrination	✅
Insults	✅
Threats	✅
Unbelievable and Fantasy stories	✅

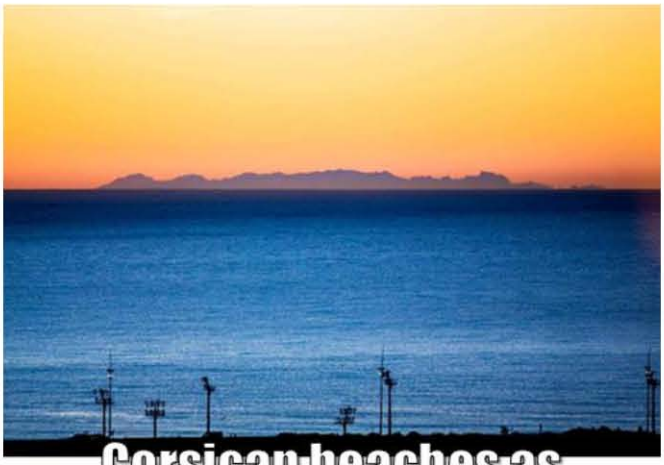
translation into English ongoing

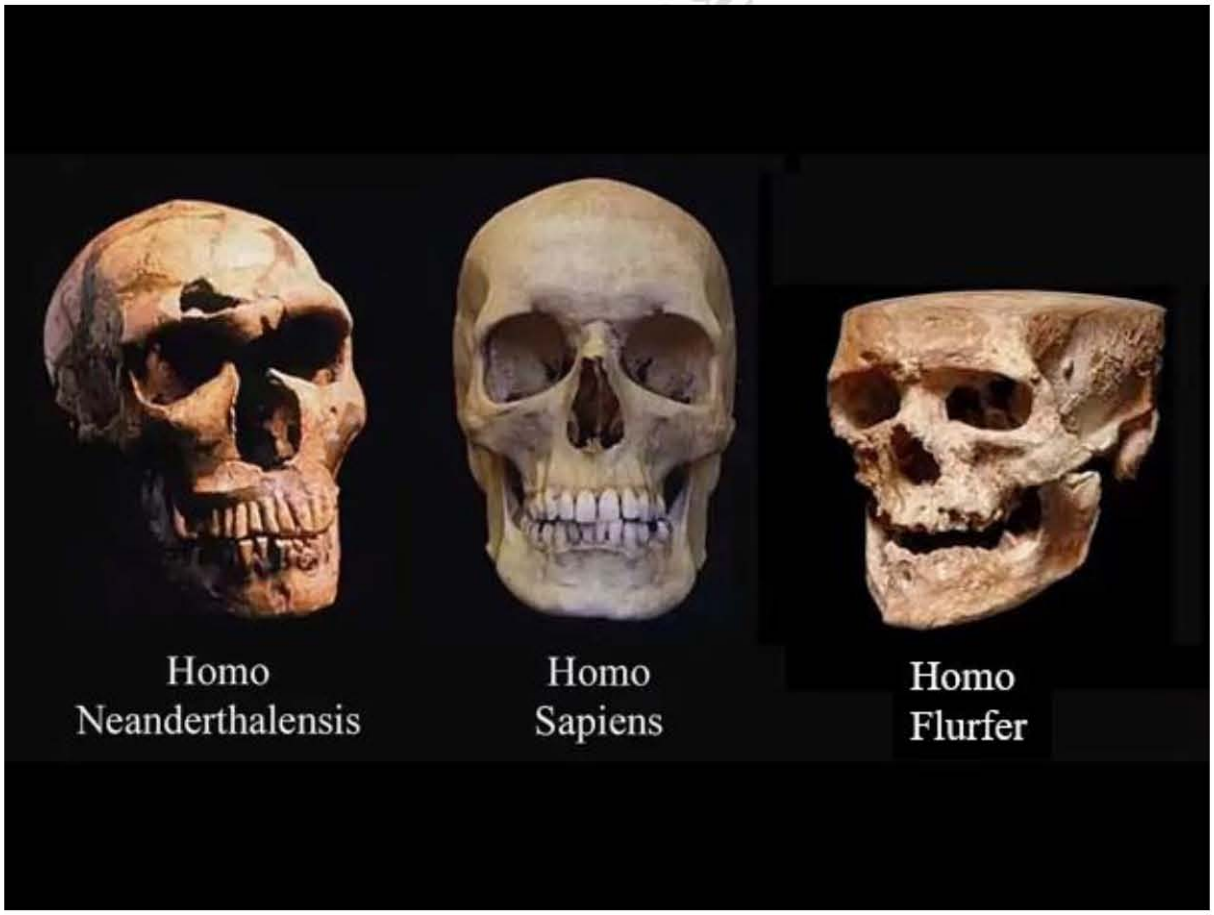

Elementary geometry and radar measurements demonstrate that the Sun is 150 million kilometers away!
The Sun is local, right behind the tree!

translation ongoing


EARTH: MAKES (APPROXIMATELY) ONE REVOLUTION AROUND THE SUN
CAN FLAT EARTHERS EXPLAIN TO US WHAT THEY ARE DOING?

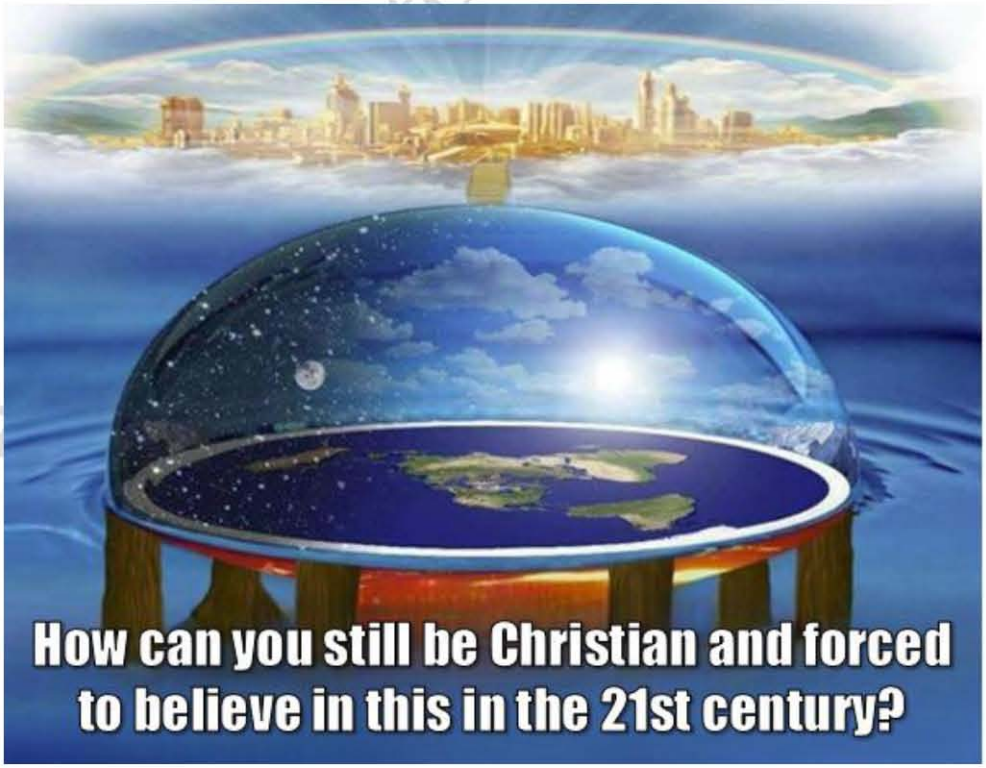
FLAT-EARTHERS WHO HESITATE BETWEEN CELEBRATING THE NEW YEAR, THEREBY ACKNOWLEDGING THAT THE EARTH IS A GLOBE ROTATING AROUND THE SUN, AND REMAINING FLAT-EARTHERS

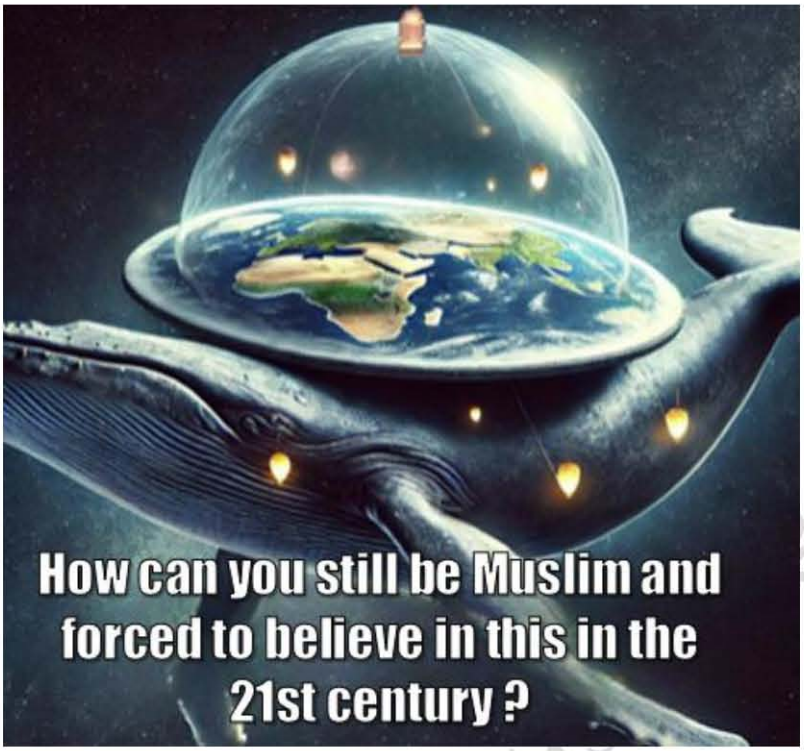

Corsican beaches as
seen from Nice thanks to
this powerful telescope

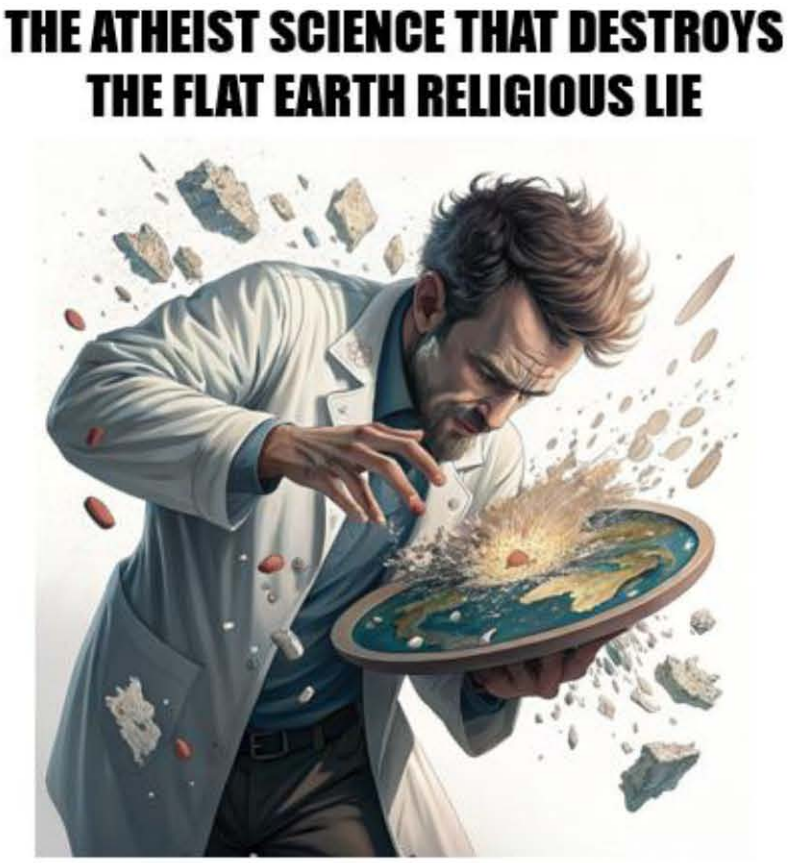

Homo
Neanderthalensis
Homo
Sapiens
Homo
Flurfer

TOYKO to NEW YORK
~11,000 km and14 hr
SYDNEY to SANTIAGO
~ 11,000 km and14 hr
TOKYO
NY
SYDNEY
SANTIAGO
Flurfer that seems confused
Air currents?
Pilots' conspiracy?
Are they flying faster?
Density?
Archimedes' principle?

FLURFERS THAT DON'T SEE
THE CURVATURE

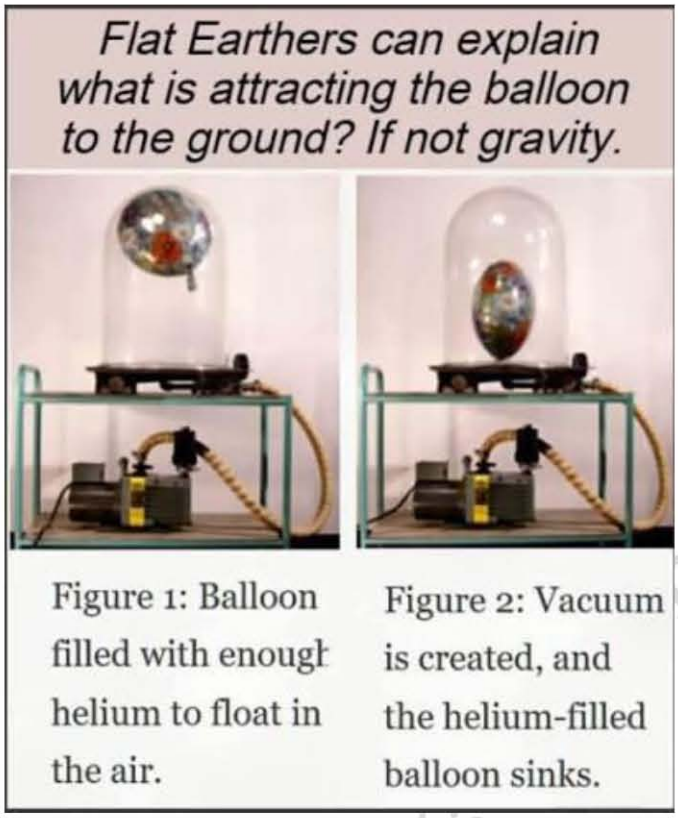

How can you still be Christian and forced
to believe in this in the 21st century?

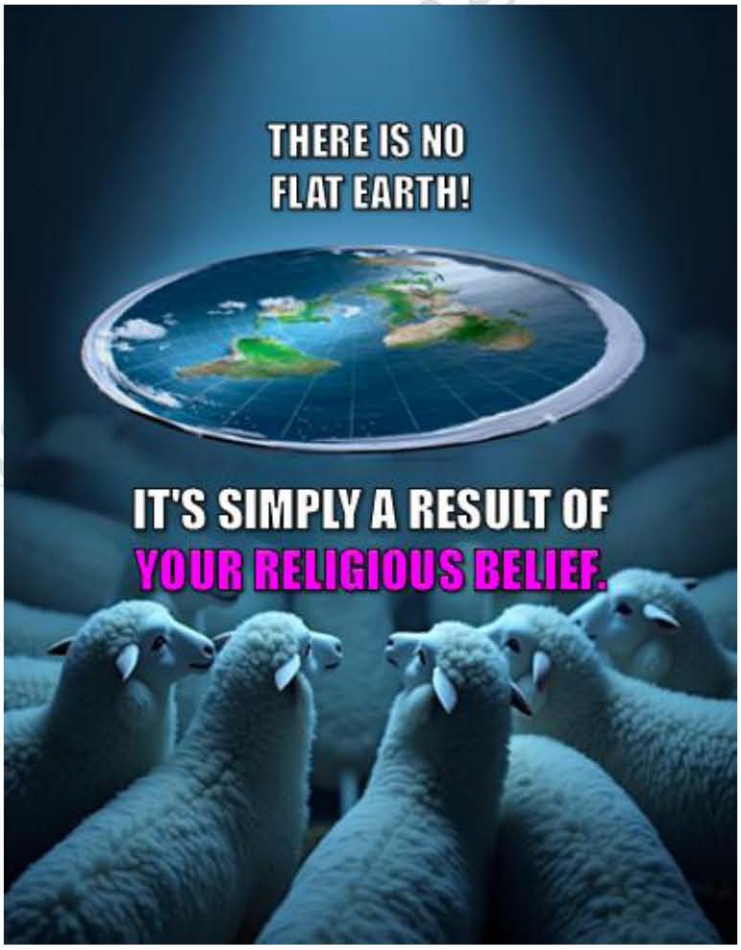

How can you still be Muslim and forced to believe in this in the 21st century ?

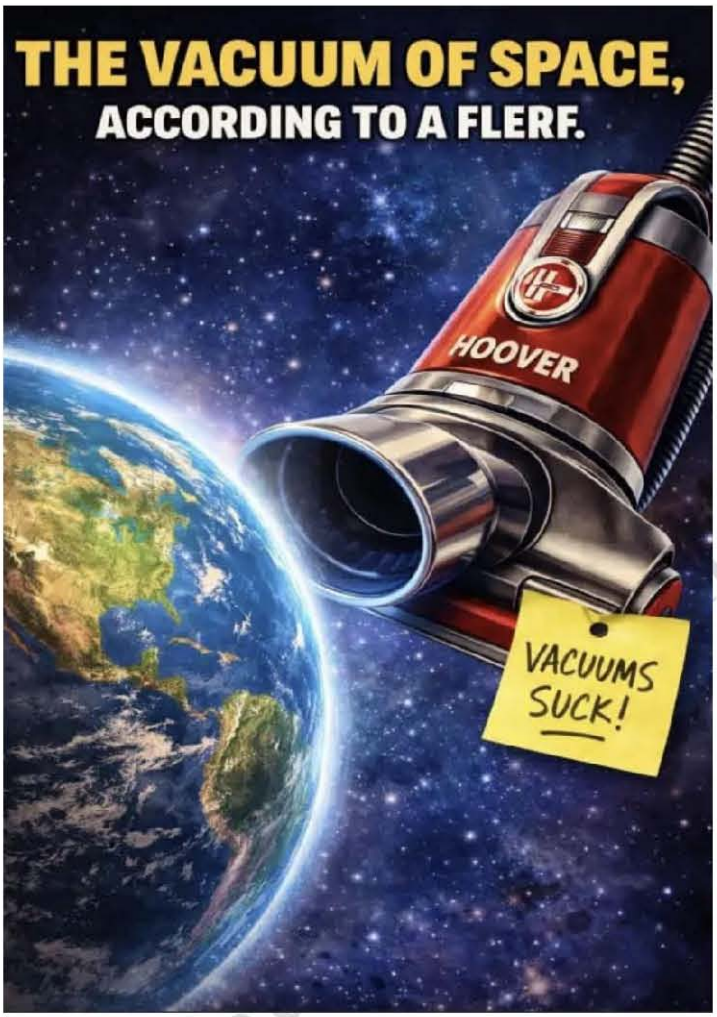

THE ATHEIST SCIENCE THAT DESTROYS THE FLAT EARTH RELIGIOUS LIE

Flurfers like videos and images. Me too!
We hide you the truth ! Proof with this picture. Cats can fly, but only those who can think know !

RARE REPRESENTATION OF A MEETING WITH THREE FLURFERS

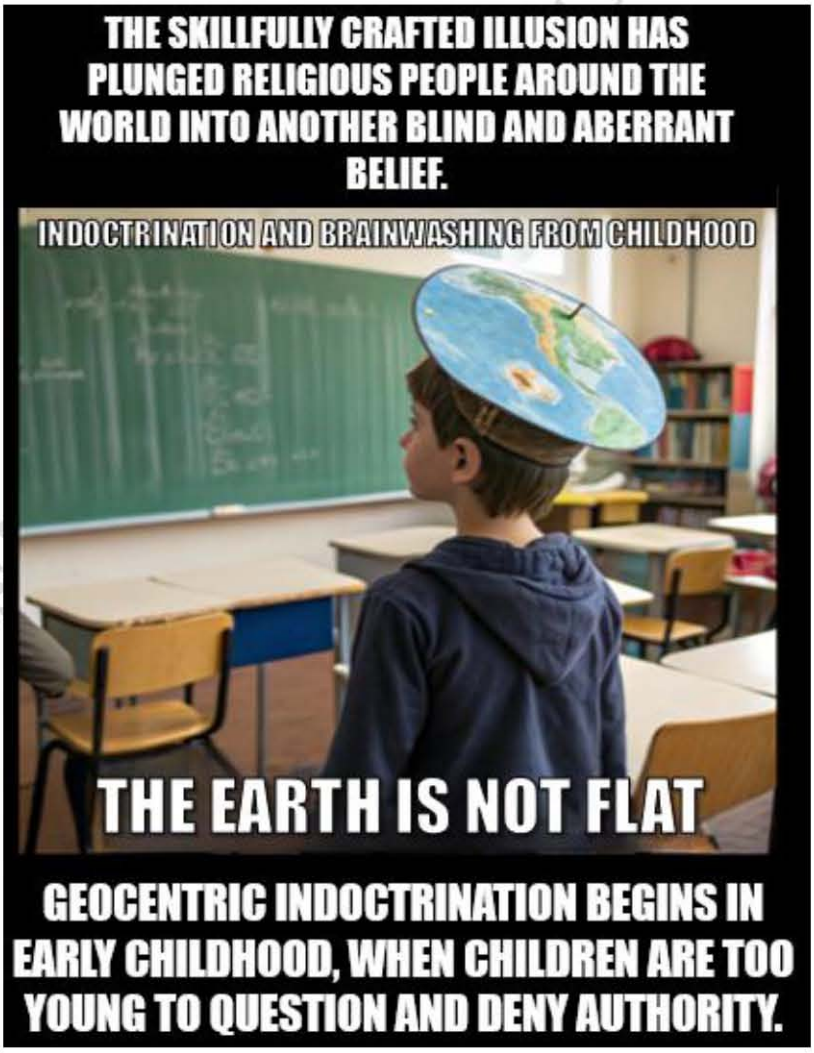

Flat Earthers can explain what is attracting the balloon to the ground? If not gravity.
Figure 1: Balloon filled with enough helium to float in the air.
Figure 2: Vacuum is created, and the helium-filled balloon sinks.


THERE IS NO FLAT EARTH!
IT'S SIMPLY A RESULT OF YOUR RELIGIOUS BELIEF.


THE VACUUM OF SPACE,
ACCORDING TO A FLERF.
HOOVER
VACUUMS SUCK!

BELIEF OF
FLAT EARTH

RESEARCH LAB FOR FLURFERS...
Activity Center

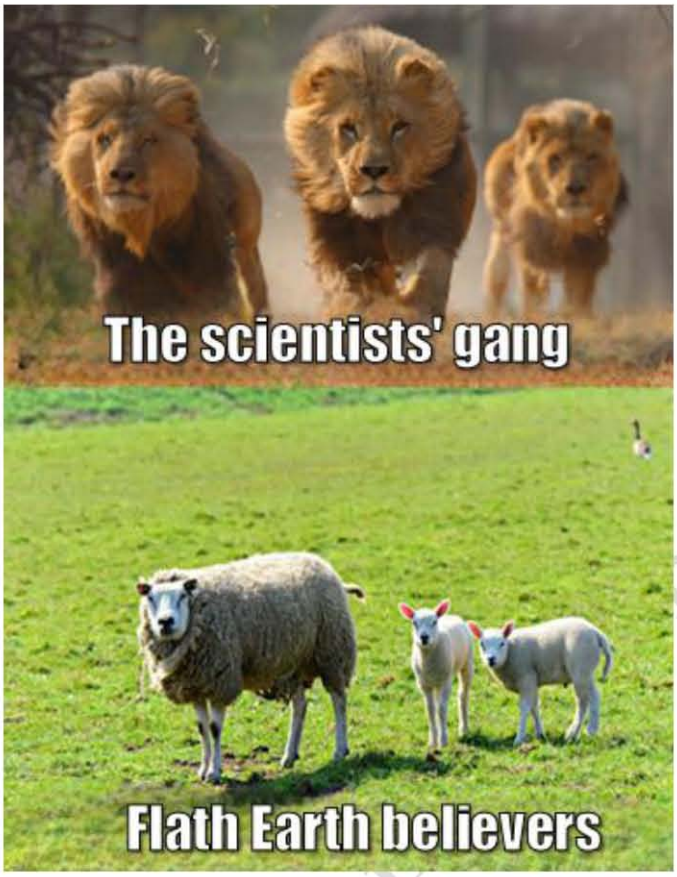

THE SKILLFULLY CRAFTED ILLUSION HAS PLUNGED RELIGIOUS PEOPLE AROUND THE WORLD INTO ANOTHER BLIND AND ABERRANT BELIEF.
INDOCTRINATION AND BRAINWASHING FROM CHILDHOOD
THE EARTH IS NOT FLAT
GEOCENTRIC INDOCTRINATION BEGINS IN EARLY CHILDHOOD, WHEN CHILDREN ARE TOO YOUNG TO QUESTION AND DENY AUTHORITY.

THE ONLY TIME WE SEE A FLAT EARTH IS THROUGH DRAWINGS, CGI AND ANIMATIONS
FRAUD
We have never seen a real video from a real camera showing the Sun disappearing below the horizon while changing size, buildings tilting more and more as we move away from the North pole, or even a flat horizon at high altitude.

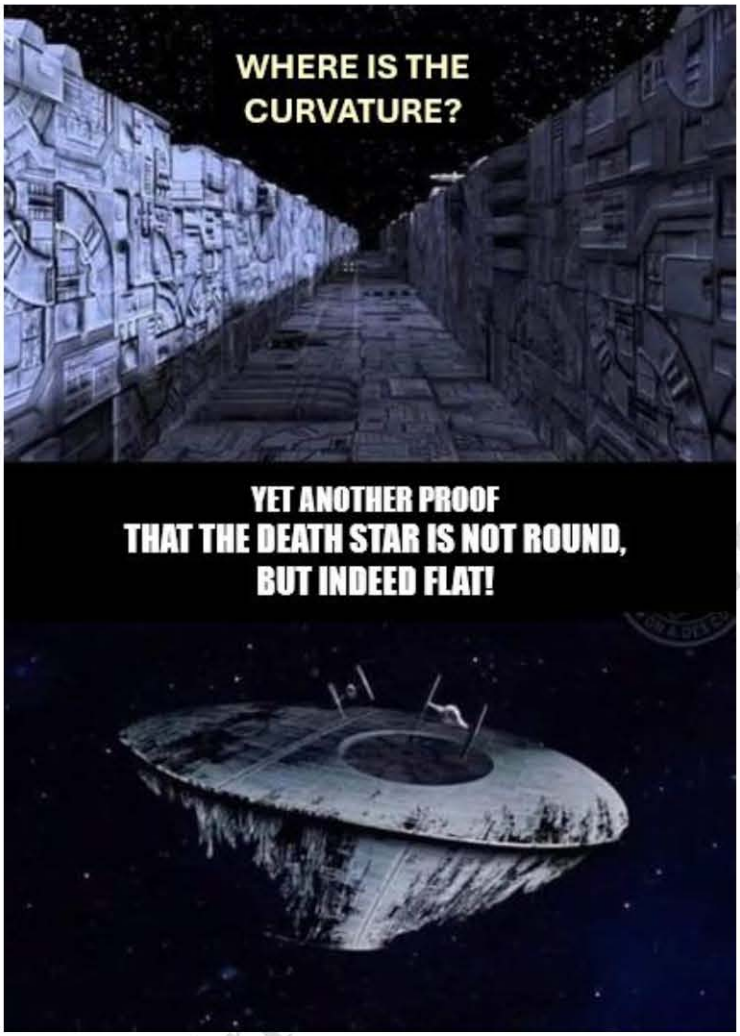
THE SUEZ CANAL, THE ULTIMATE PROOF THAT THE EARTH IS NOT FLAT
The water curves, the canal water is never flat!
MAERSK

REAL PHOTOS OF THE EARTH FROM AN ALTITUDE OF MORE THAN 30 KM
I don't see any curvature here

THE MOST BASIC FORM OF MIND CONTROL
IS REPETITION



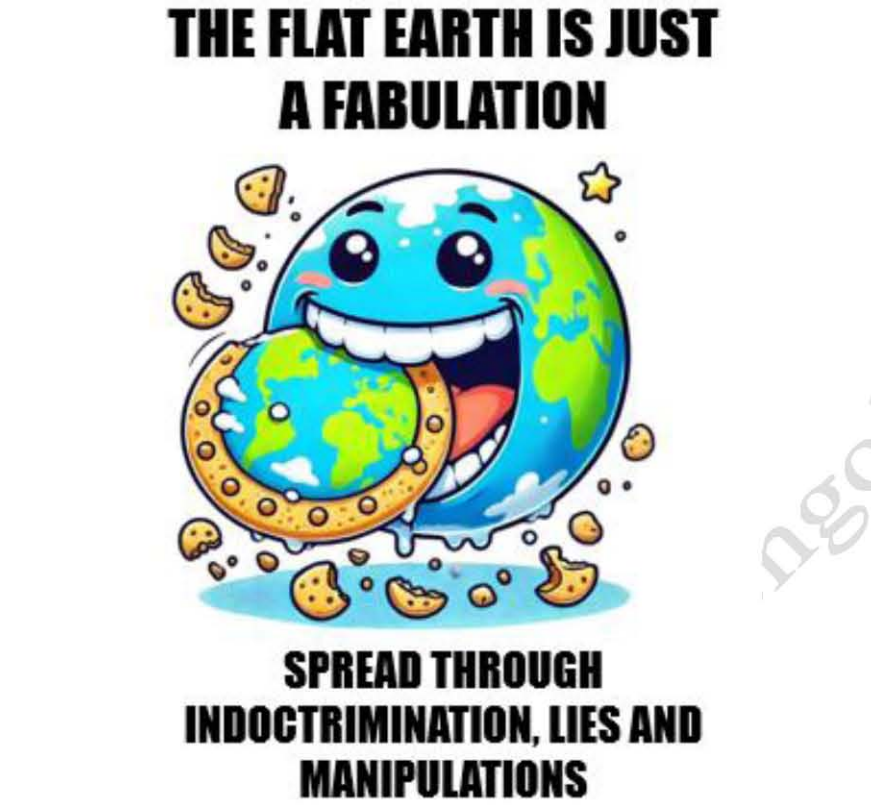
translation into

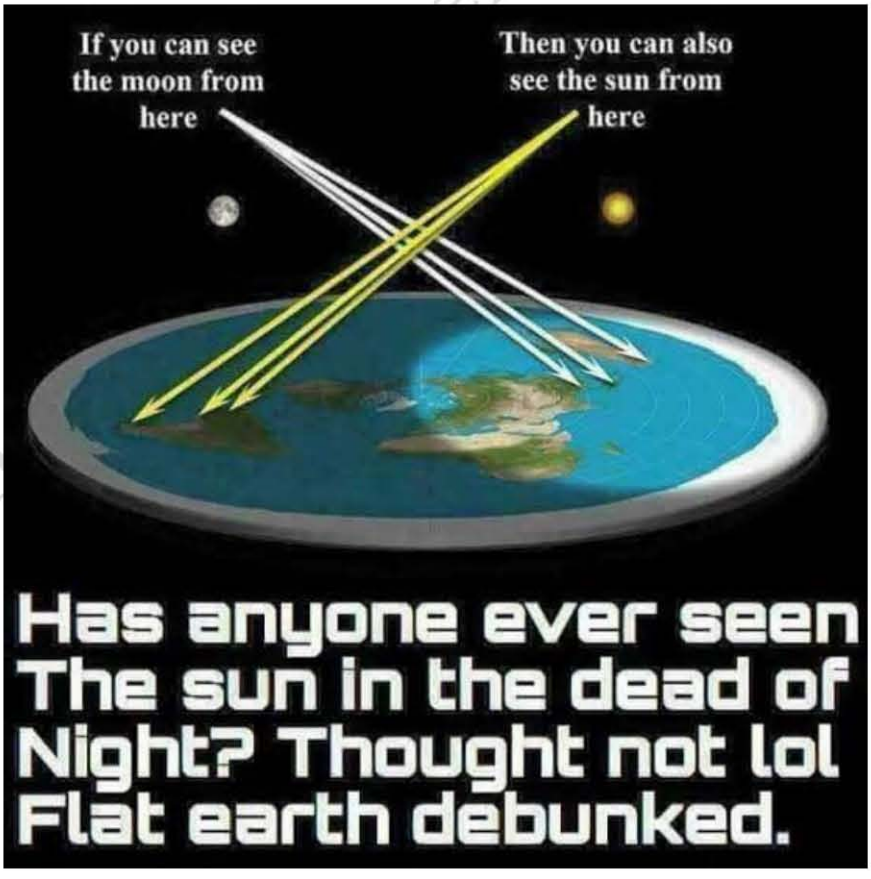

WHERE IS THE
CURVATURE?
YET ANOTHER PROOF
THAT THE DEATH STAR IS NOT ROUND,
BUT INDEED FLAT!

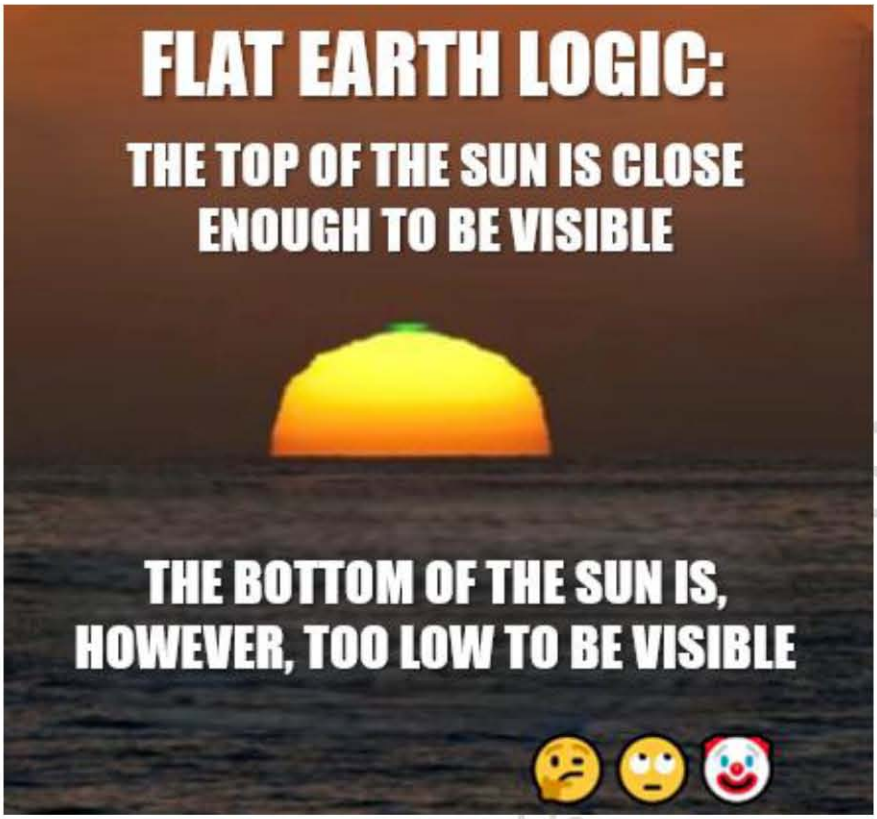
Things that adults should no
longer believe...

ALL PILOTS KNOW THAT!
THE EARTH IS A GLOBE, THE GYROSCOPE PROVES IT.

THE PROOFS OF THE FLAT EARTH
There is a dome, but you will never touch it
There is a model, but you'll never see it
There are geostationary stratospheric balloons for digital TV & Weather but you will never see them

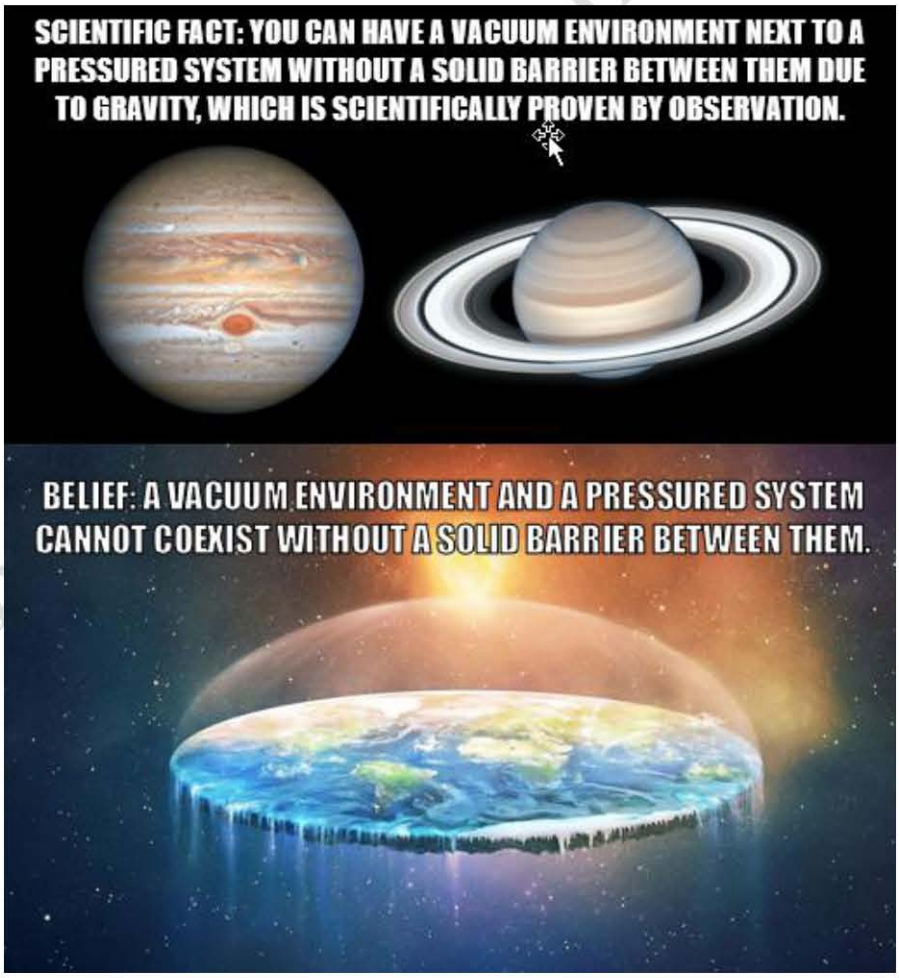

THE FLAT EARTH IS JUST
A FABULATION
SPREAD THROUGH
INDOCTRIMINATION, LIES AND
MANIPULATIONS


If you can see the moon from here
Then you can also see the sun from here
Has anyone ever seen The sun in the dead of Night? Thought not lol Flat earth debunked.


FLAT EARTH LOGIC:
THE TOP OF THE SUN IS CLOSE ENOUGH TO BE VISIBLE
THE BOTTOM OF THE SUN IS, HOWEVER, TOO LOW TO BE VISIBLE

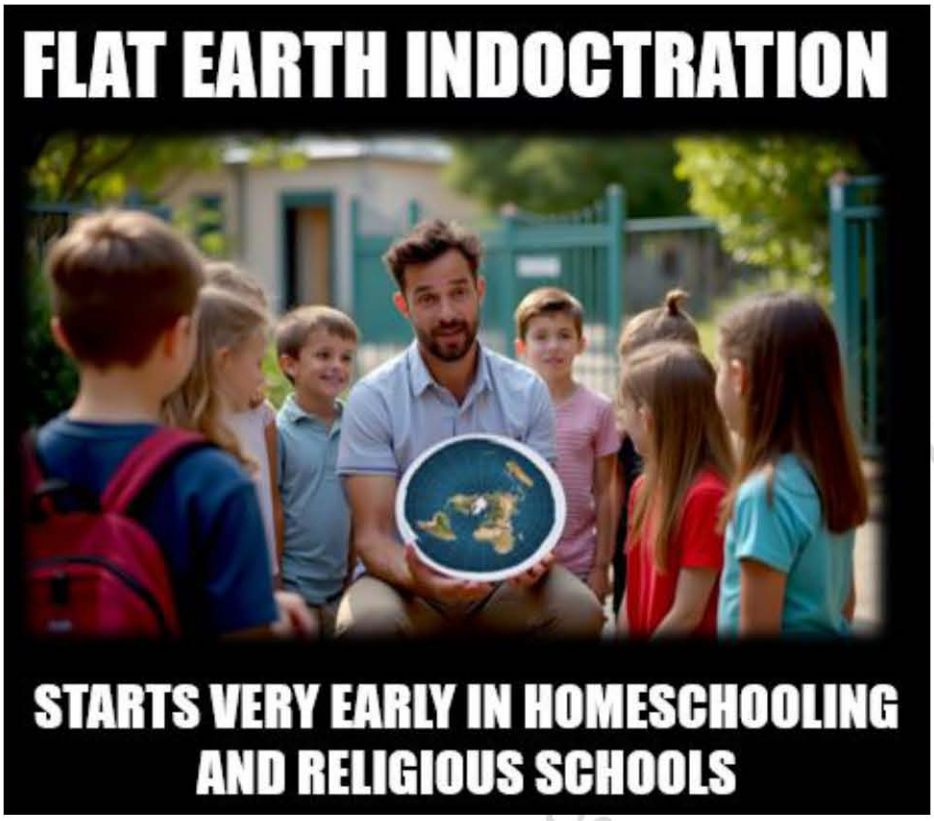
THE EARTH IS A GLOBE
THE EARTH IS A GLOBE
THE EARTH IS A GLOBE
THE EARTH IS A GLOBE
THE EARTH IS A GLOBE
THE EARTH IS FLAT

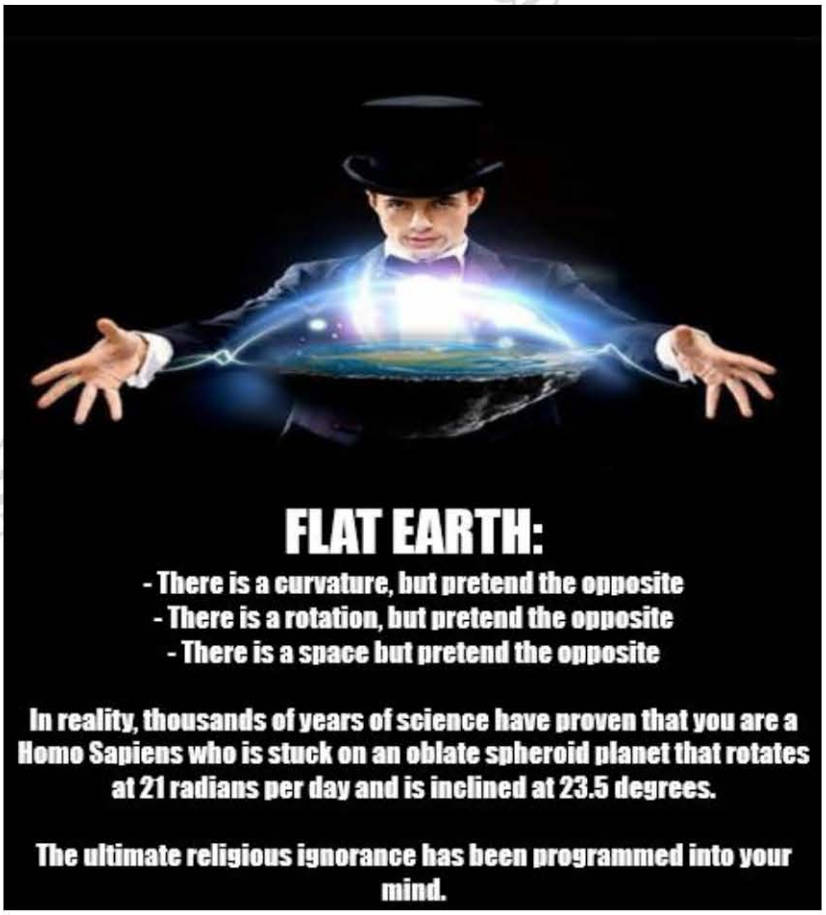
IF THE EARTH WAS FLAT...
THERE WOULD BE
NO SEASONS!

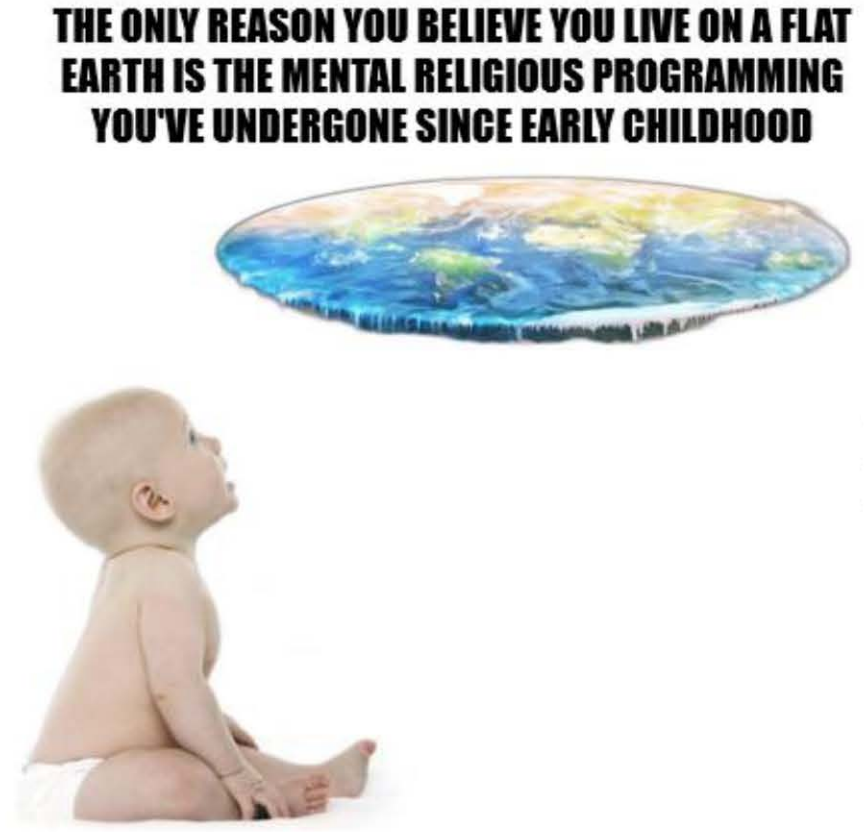

SCIENTIFIC FACT: YOU CAN HAVE A VACUUM ENVIRONMENT NEXT TO A PRESSURED SYSTEM WITHOUT A SOLID BARRIER BETWEEN THEM DUE TO GRAVITY, WHICH IS SCIENTIFICALLY PROVEN BY OBSERVATION.
BELIEF: A VACUUM ENVIRONMENT AND A PRESSURED SYSTEM CANNOT COEXIST WITHOUT A SOLID BARRIER BETWEEN THEM.

ONCE THE FLAT EARTH LIE IS EXPOSED:
THE ORGANISED RELIGIONS COLLAPSE!
WHAT EXPOSED THE FACT THAT ISLAM IS A LIE
WHAT EXPOSED THE FACT THAT CHRISTIANITY IS A LIE
WHAT EXPOSED THE FACT THAT JUDAISM IS A LIE
WHAT EXPOSED THE FACT THAT HINDUISM IS A LIE
and when we finally realize that we have been indoctrinated about everything, we can then begin to discover who we really are and why we are here.

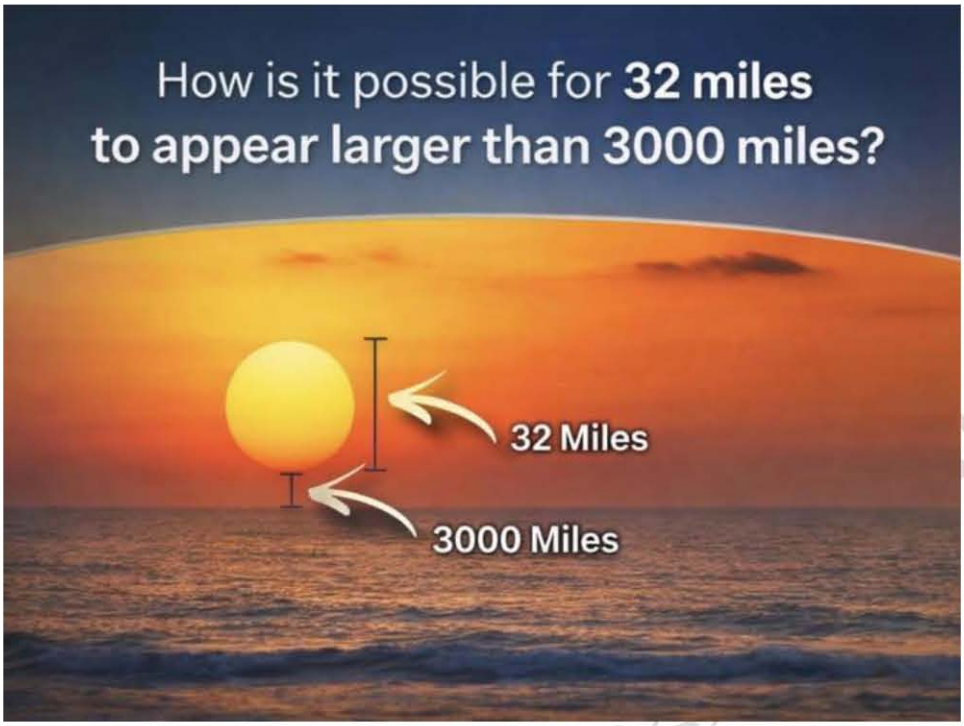
LES PRINCIPAUX ÉCHECS DE LA TERRE PLATE
1. No dome observed or photographed
2. No functional physical model
3. Cannot explain the Midnight Sun in Antarctica
4. Cannot explain the gnomon at the equinoxes


FLAT EARTH INDOCTRATION
STARTS VERY EARLY IN HOMESCHOOLING AND RELIGIOUS SCHOOLS

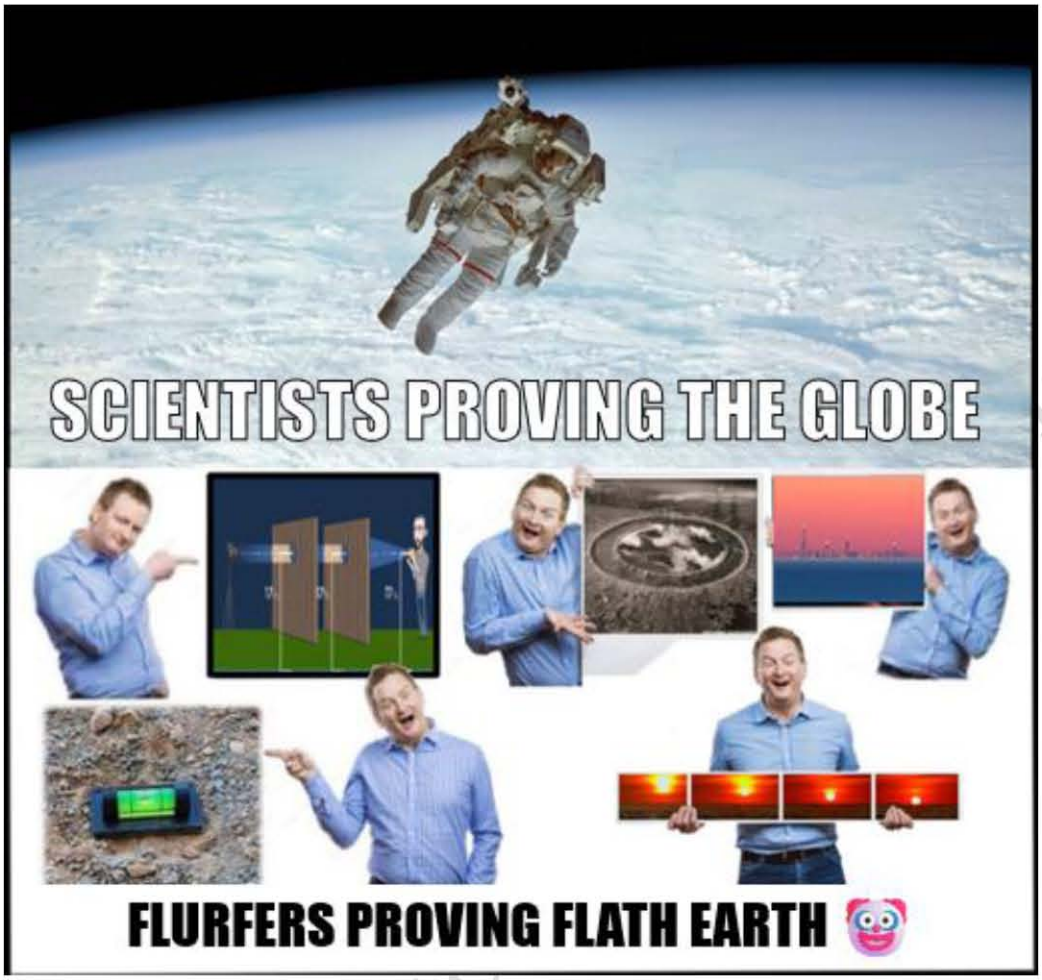

FLAT EARTH:
- There is a curvature, but pretend the opposite
- There is a rotation, but pretend the opposite
- There is a space but pretend the opposite
In reality, thousands of years of science have proven that you are a Homo Sapiens who is stuck on an oblate spheroid planet that rotates at 21 radians per day and is inclined at 23.5 degrees.
The ultimate religious ignorance has been programmed into your mind.


THE ONLY REASON YOU BELIEVE YOU LIVE ON A FLAT EARTH IS THE MENTAL RELIGIOUS PROGRAMMING YOU'VE UNDERGONE SINCE EARLY CHILDHOOD

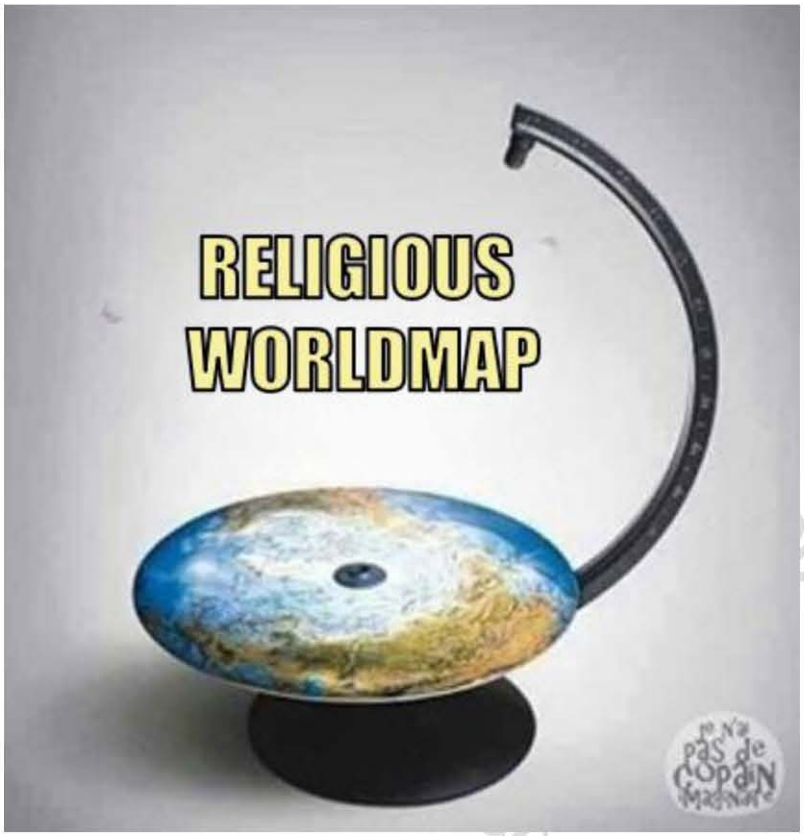
Think about it...
WHAT WAS YOUR AGE WHEN THEY TOLD YOU THAT THE EARTH WAS FLAT?
DID THEY SHOW ANY PROOFS?
But you have accepted it without any questions and stored inside your head isn't it?
There are no real photos of a flat Earth. All the images you see of a flat Earth are fake, just art.


How is it possible for 32 miles
to appear larger than 3000 miles?
32 Miles
3000 Miles

Railways converge because they
are parallels
Crepuscular rays converge
because they are not parallels
#FlurferLogic

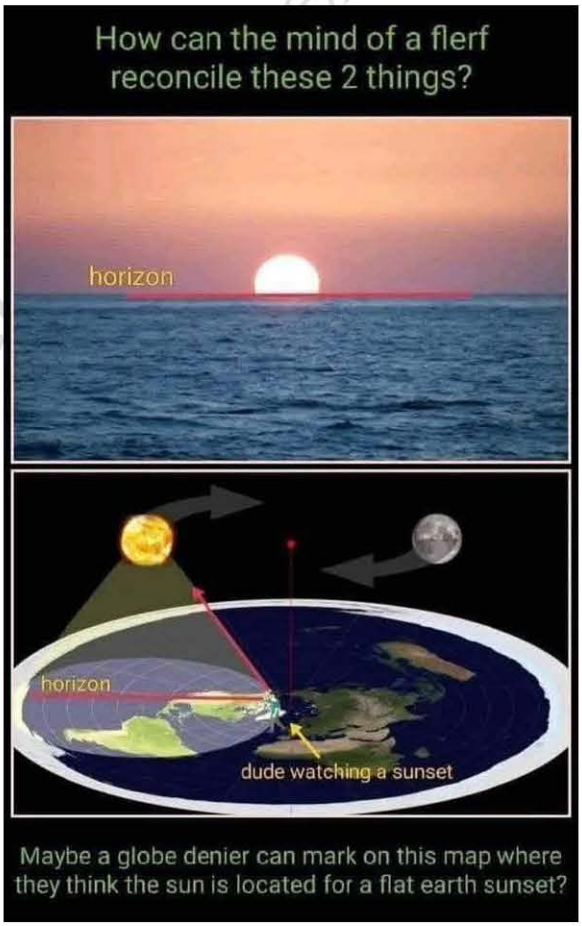

SCIENTISTS PROVING THE GLOBE
FLURFERS PROVING FLATH EARTH

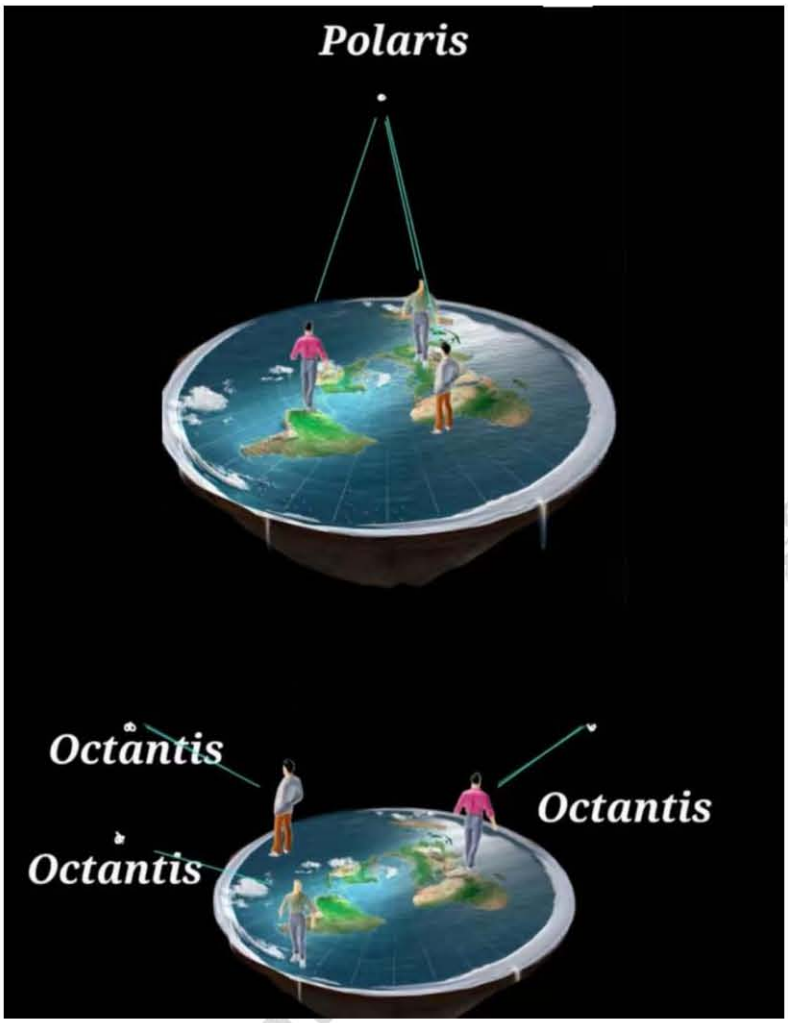
REALITY OF THE SPHERICAL EARTH
PAINTING OF THE FLAT EARTH

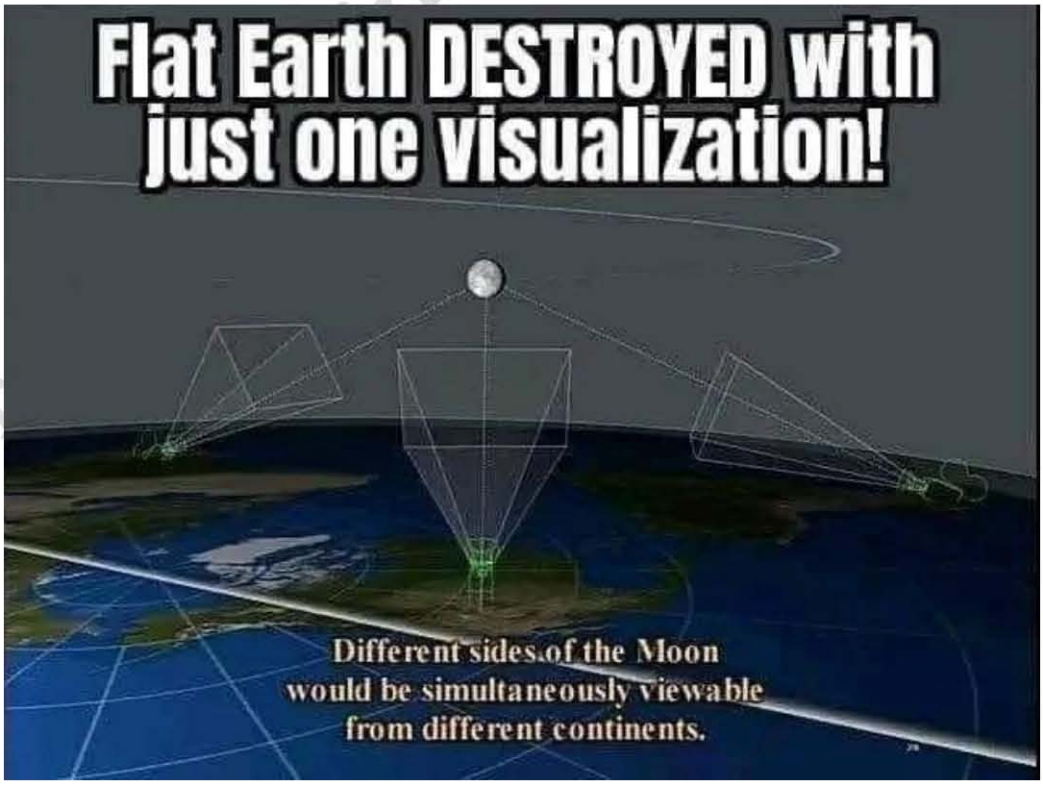

RELIGIOUS
WORLDMAP

When flurfers say that the Sun is in the cloud!

My precious
FAKE!!!

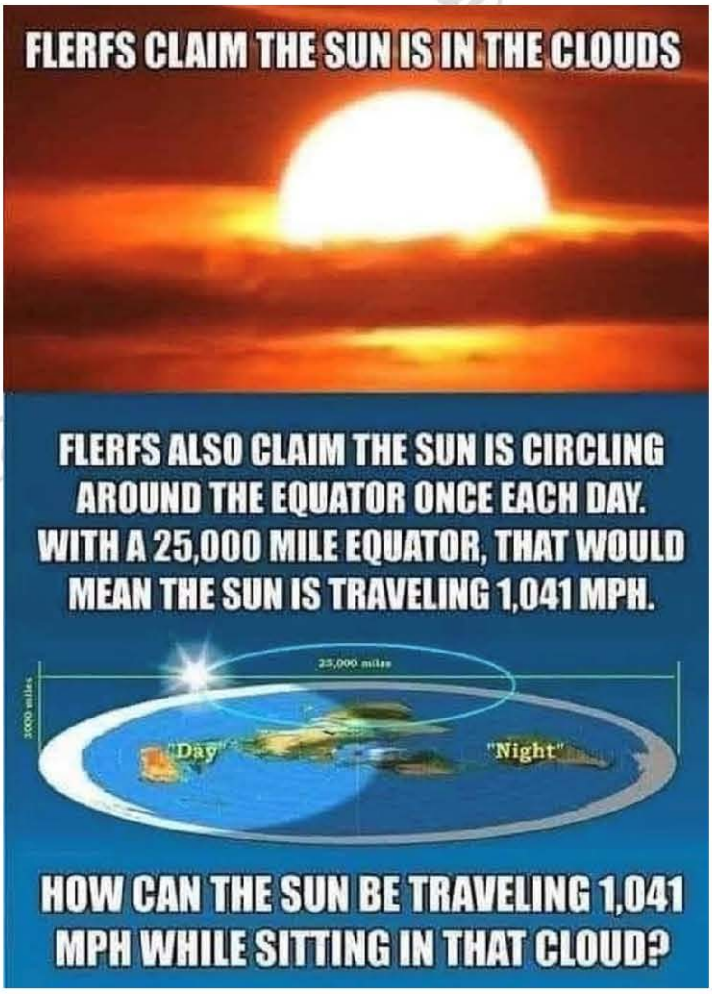

How can the mind of a flerf reconcile these 2 things?
horizon
horizon
dude watching a sunset
Maybe a globe denier can mark on this map where they think the sun is located for a flat earth sunset?


Polaris
Octantis
Octantis
Octantis

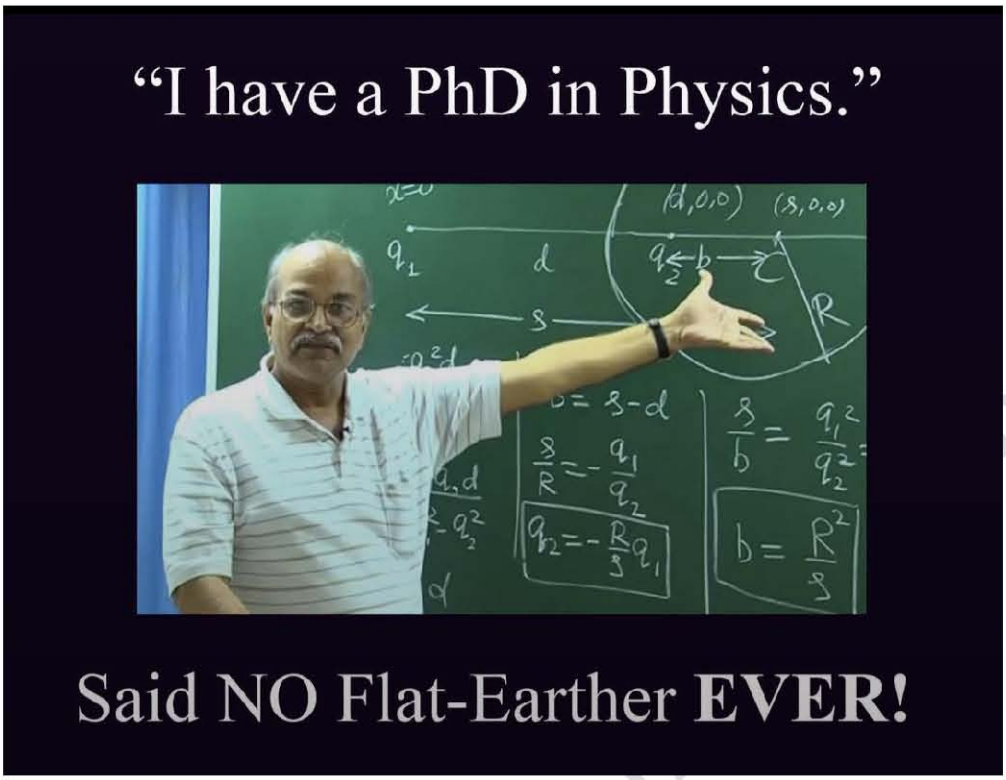

Flat Earth DESTROYED with just one visualization!
Different sides of the Moon would be simultaneously viewable from different continents.

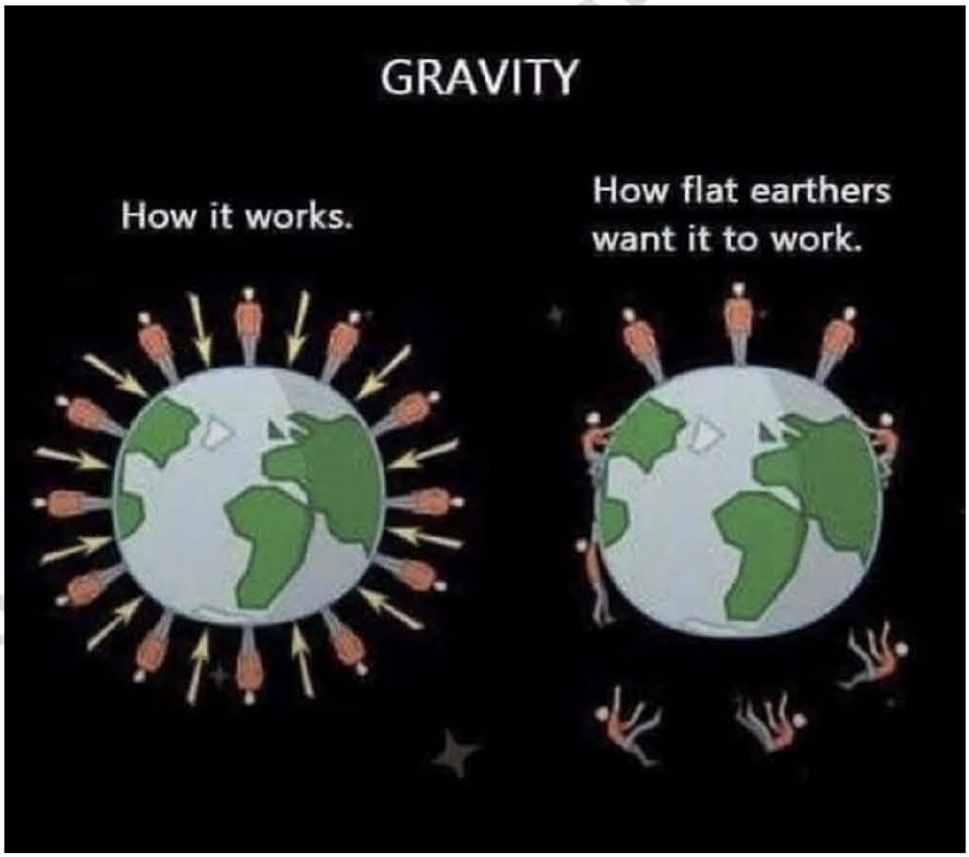
Studys they dont do nothin, its payed by the superiour teachin who is payed by the state who is payed by nasa. Insted of doin studys that make you swollow all what the globtards say, its better to do your own researsh. Its long and complikated but its the rode of the truth.

Flat-Earthers when they realize that they breathe the atmosphere and not the atmodisc.


FLERFS CLAIM THE SUN IS IN THE CLOUDS
FLERFS ALSO CLAIM THE SUN IS CIRCLING AROUND THE EQUATOR ONCE EACH DAY. WITH A 25,000 MILE EQUATOR, THAT WOULD MEAN THE SUN IS TRAVELING 1,041 MPH.
25,000 miles
3000 miles
"Day"
"Night"
HOW CAN THE SUN BE TRAVELING 1,041 MPH WHILE SITTING IN THAT CLOUD?

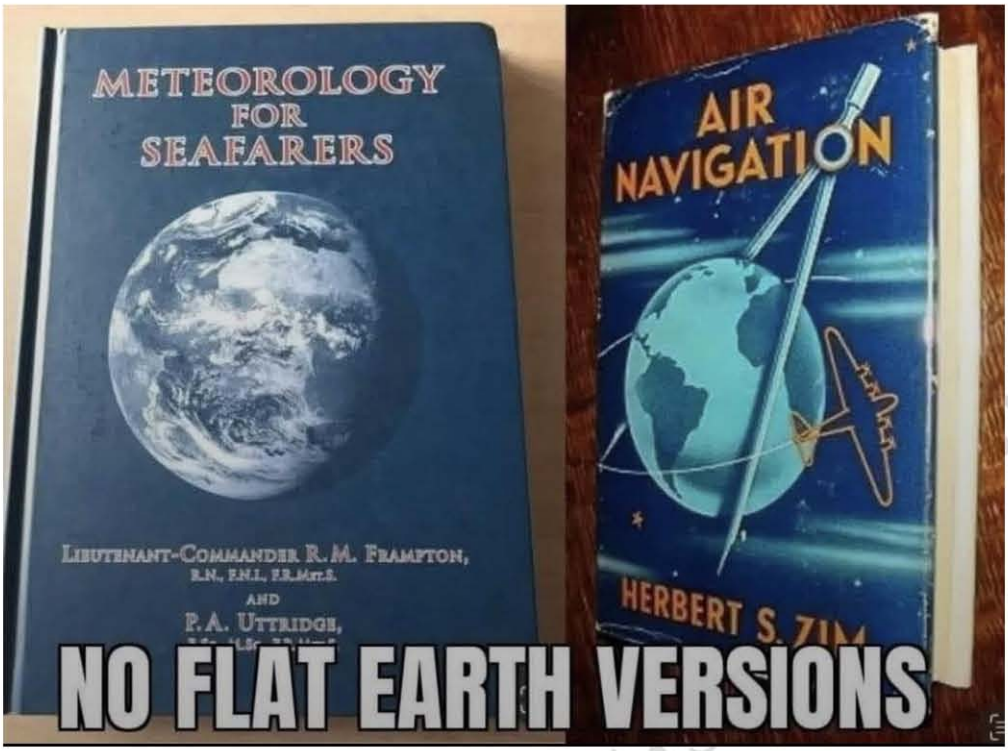
translation in progress


"I have a PhD in Physics."
Said NO Flat-Earther EVER!

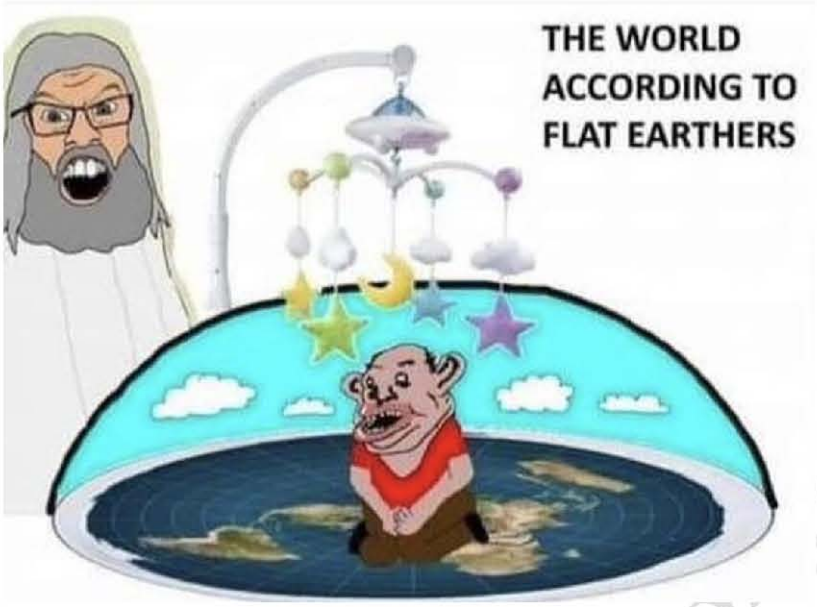

GRAVITY
How it works.
How flat earthers want it to work.

IF THE SUN WERE LOCAL
A SUNDIAL WOULD SHOW
DIFFERENT TIMES...
HERE
HERE
HERE
HERE
HERE
HERE
imgflip.com

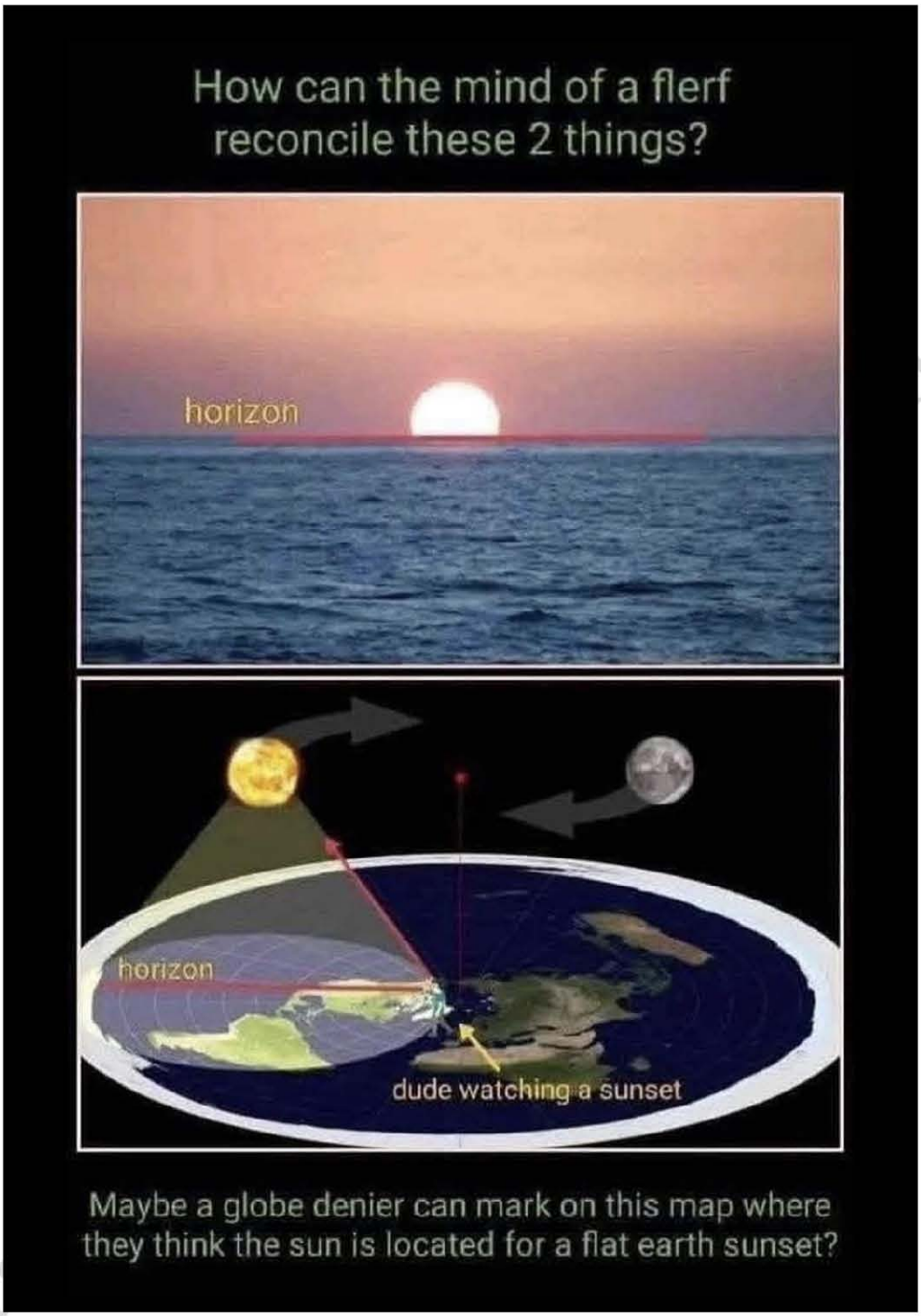
MUSEUM OF
FLAT EARTH
EVIDENCE


METEOROLOGY FOR SEAFARERS
LIEUTENANT-COMMANDER R. M. FRAMPTON,
AND
P. A. UTTRIDGE,
AIR NAVIGATION
HERBERT S. ZIM
NO FLAT EARTH VERSIONS

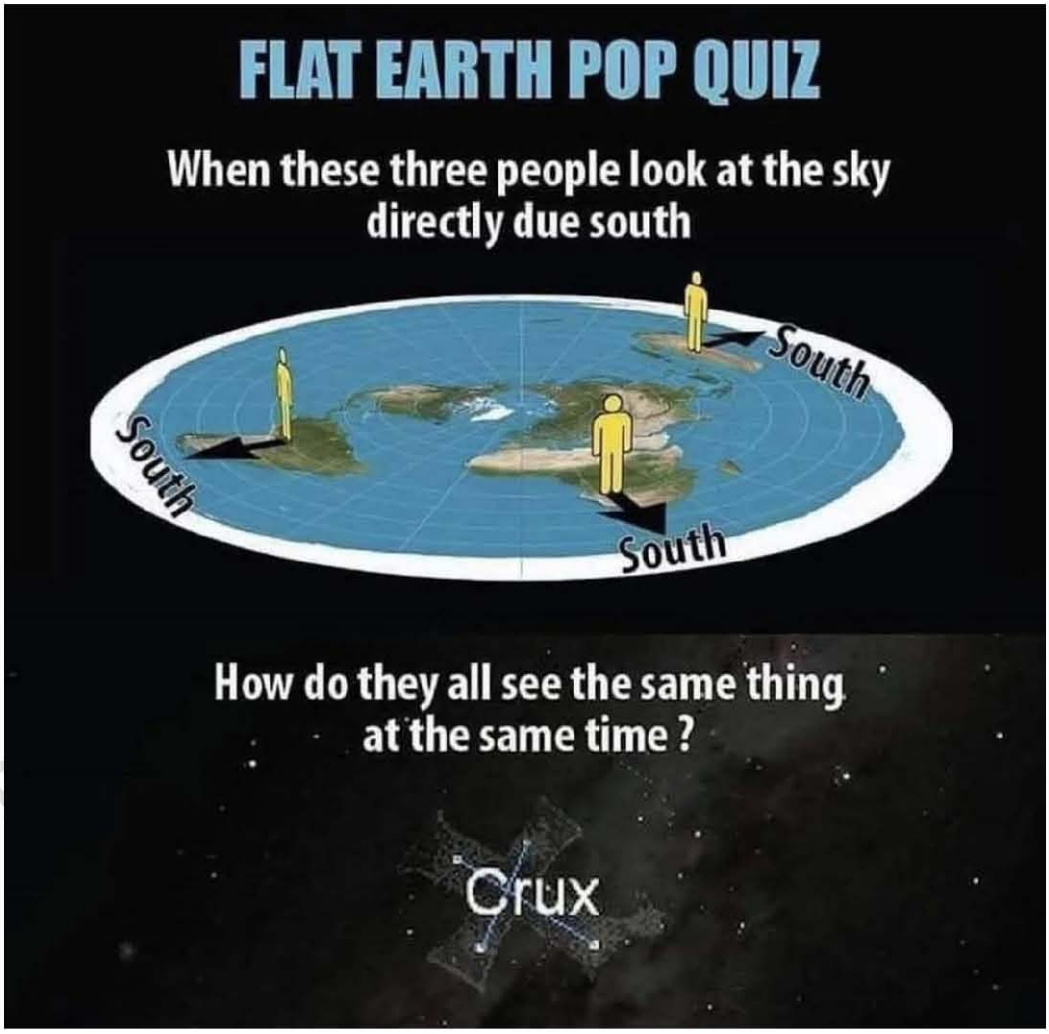
FLAT EARTHR SCIENCE STARTER PACK
Earth is flat
Diameter: unknown
Area: unknown
Dome material: unknown
Dome altitude: unknown
Dome proof: none
Polaris seen from south: nope
Sun's composition: ¯\(ツ)/¯
Sun's shape & altitude: ???
Moon: mysterious rock light
Earthquakes: who knows
Climate: "Sky's angry?"
Precise maps: none
South Pole midnight sun: ignored
Time zones: faked
50% sunlight on Earth: impossible math
Time zones: faked
50% sunlight on Earth: impossible math
Sunset curve: Photoshop!
Tides: "Móon's mood?"
Eclipses: "shadow aliens?"
So many unknowns... but hey, at least it's flat.


THE WORLD
ACCORDING TO
FLAT EARTHERS

%1000 PROOF OF LOCAL SUN
SUN AT 20 FT OVER MY HOUSE
BALL EARTH DEBUNKED
imgflip.com


How can the mind of a flerf reconcile these 2 things?
horizon
horizon
dude watching a sunset
Maybe a globe denier can mark on this map where they think the sun is located for a flat earth sunset?

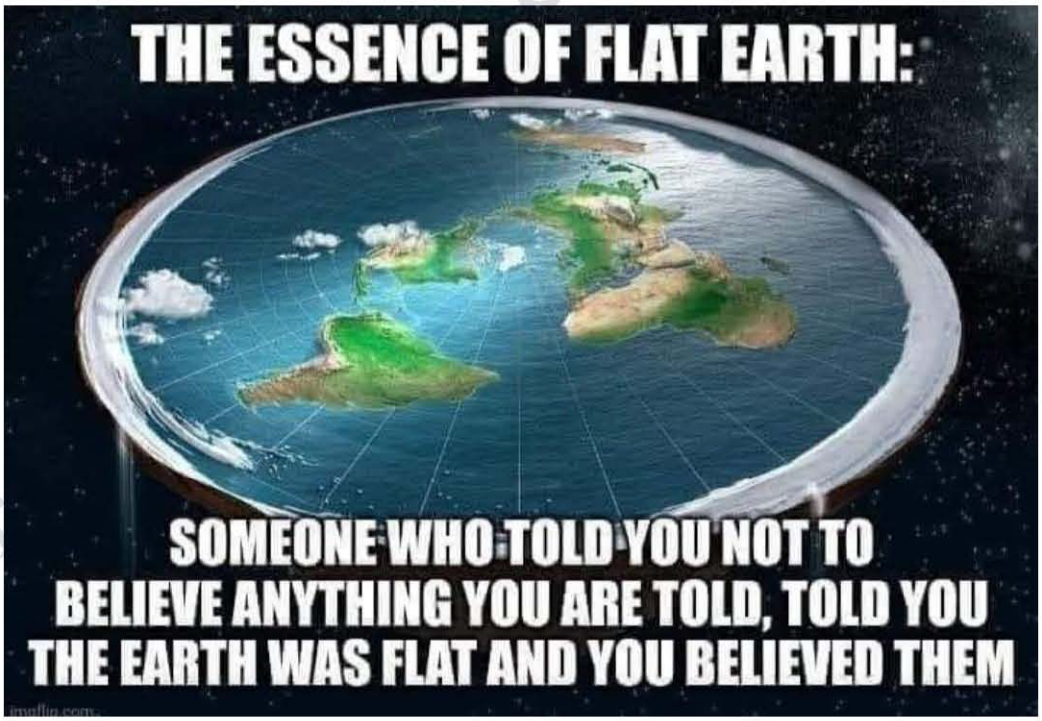
Vacuums
don't suck..
The
so-called
flat-Earth
evidence
does!

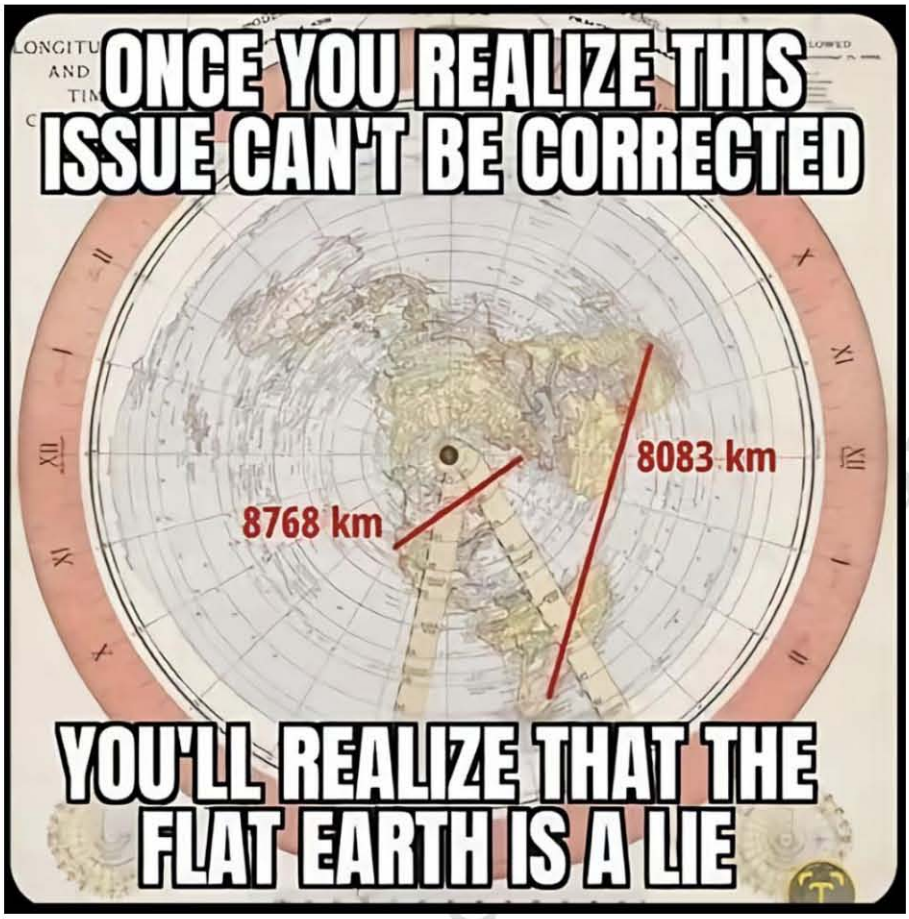

FLAT EARTH POP QUIZ
When these three people look at the sky
directly due south
South
South
South
How do they all see the same thing
at the same time ?
Crux

According to flat earthers.
Zooming in will bring the whole cat back into view.

A PAINTING!
A CARTOON!
CGI!
Oh yes, that's real, that is.
I ♥ TO FLERF

FUTURE DOCTOR
FUTURE TEACHER
FUTURE ENGINEER
FUTURE SCIENTIST
FUTURE FLURFER WHO TELLS EVERYONE "OPEN YOUR EYES AND DO YOUR OWN OBSERVATIONS AND RESEARCH, SHEEP!"


THE ESSENCE OF FLAT EARTH:
SOMEONE WHO TOLD YOU NOT TO BELIEVE ANYTHING YOU ARE TOLD, TOLD YOU THE EARTH WAS FLAT AND YOU BELIEVED THEM


ONCE YOU REALIZE THIS ISSUE CAN'T BE CORRECTED
8768 km
8083 km
YOU'LL REALIZE THAT THE FLAT EARTH IS A LIE

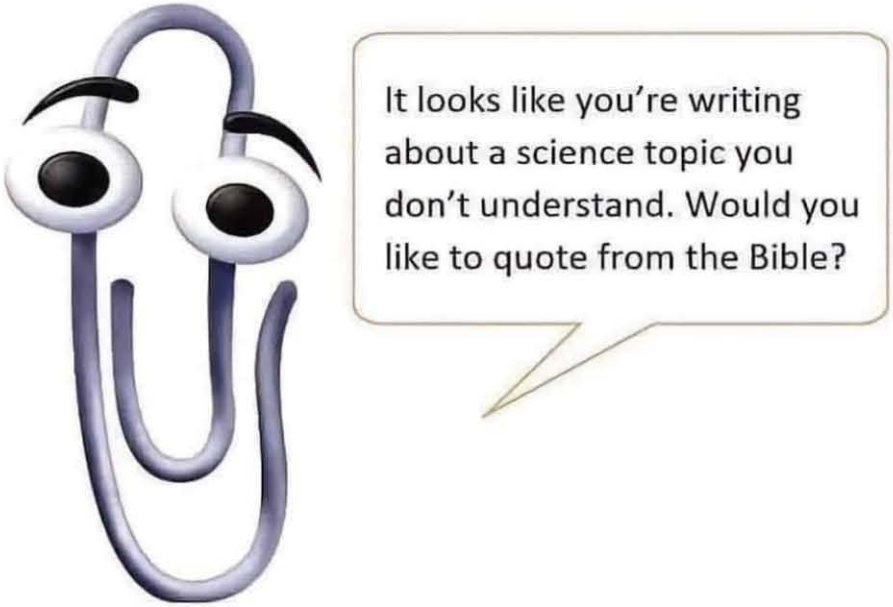
FLAT EARTH SOCIETY

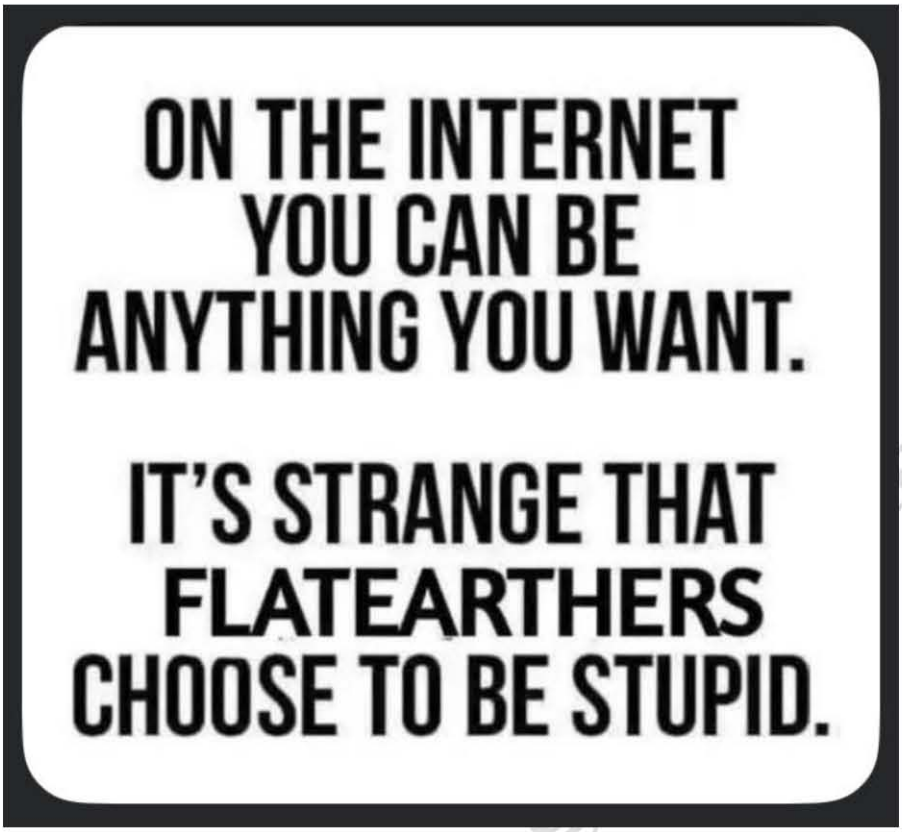
FLAT EARTHERS' NEXT
FLAT EARTH MODEL TEAM.

No flat earther has ever said anything intelligent or scientifically correct.. Ever
CHANGE MY MIND

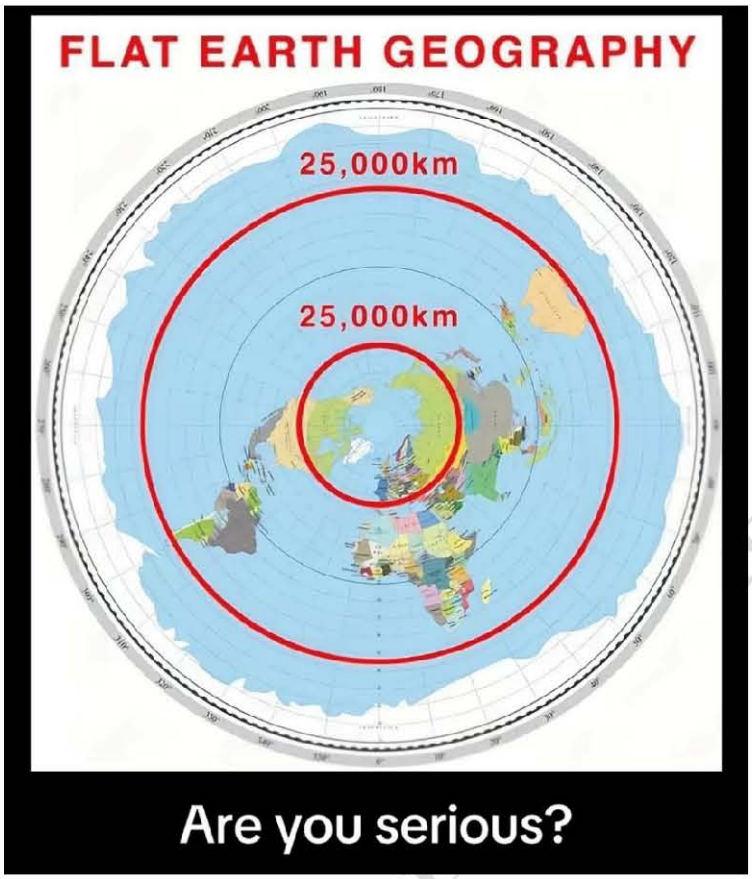
translation ongoing

32 Miles
3000 Miles
32 Miles > 3000 Miles.
Perspective is a bitch !!


It looks like you're writing about a science topic you don't understand. Would you like to quote from the Bible?


ON THE INTERNET
YOU CAN BE
ANYTHING YOU WANT.
IT'S STRANGE THAT
FLATEARTHERS
CHOOSE TO BE STUPID.

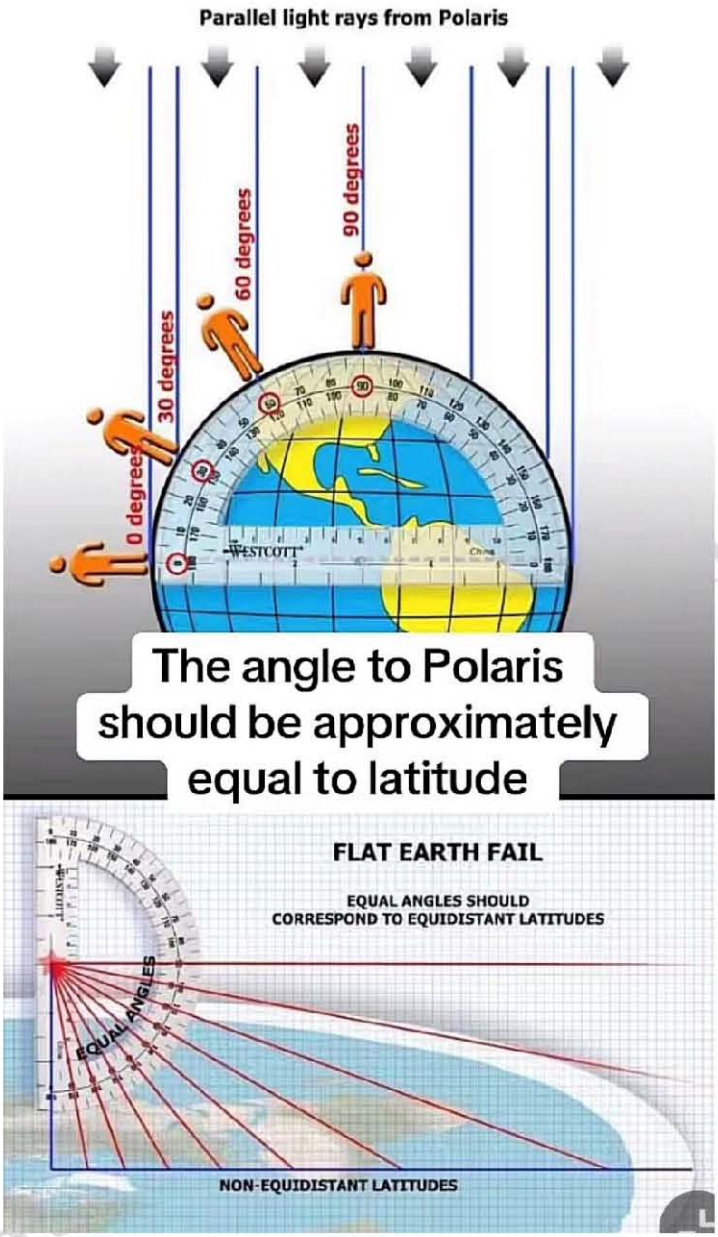
PROOF THE EARTH IS FLAT!
WELL THAT'S EMBARRASSING


FLAT EARTH GEOGRAPHY
25,000km
25,000km
Are you serious?

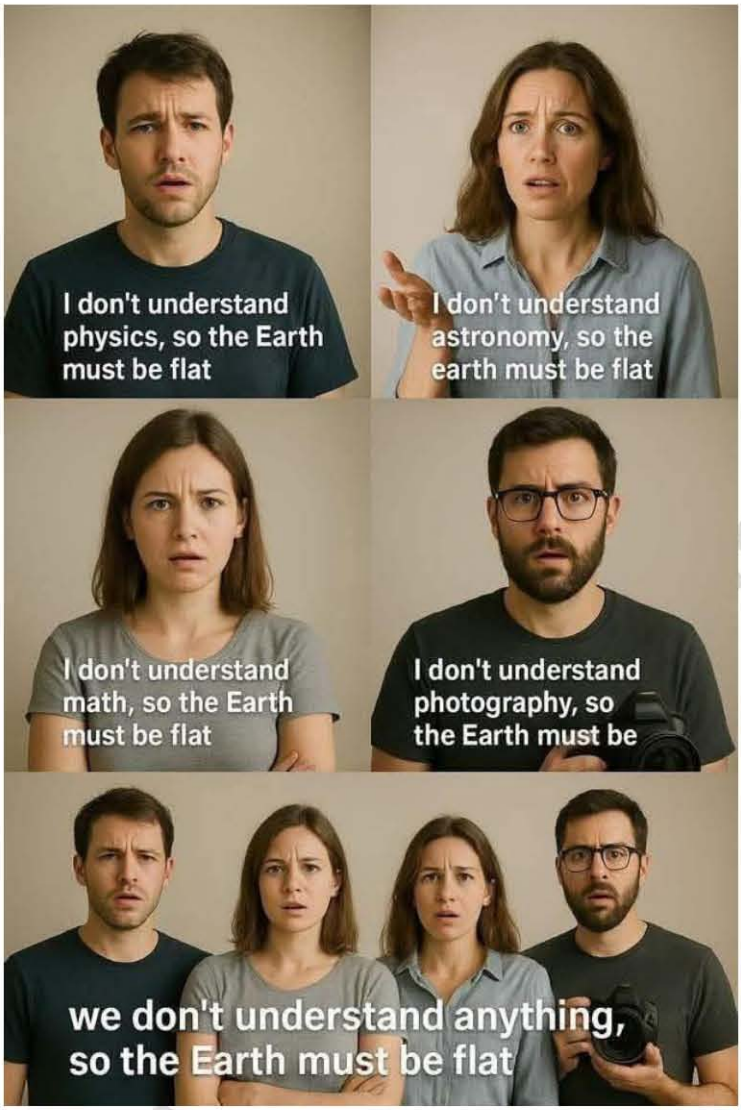
Water Doesn't Bend
OOPS

The Flat Earth
"MAP CHALLENGE
Goal: Design one accurate Flat Earth map that satisfies ALL of these conditions:
Is fully accurate with all known distances and makes sense of continents
Is based on reality, not NASA or space agencies
Works with all navigation, shipping, and flight routes
Works everywhere—from Antarctica to the equator
Accurately explains what is at the outer edge
Matches all known sunrise and sunset times
MAGELLAN
GPS
Tired of hiding your map?
Show the world your Flat Earth map that meets all of the requirements
TikTok

translation ongoing

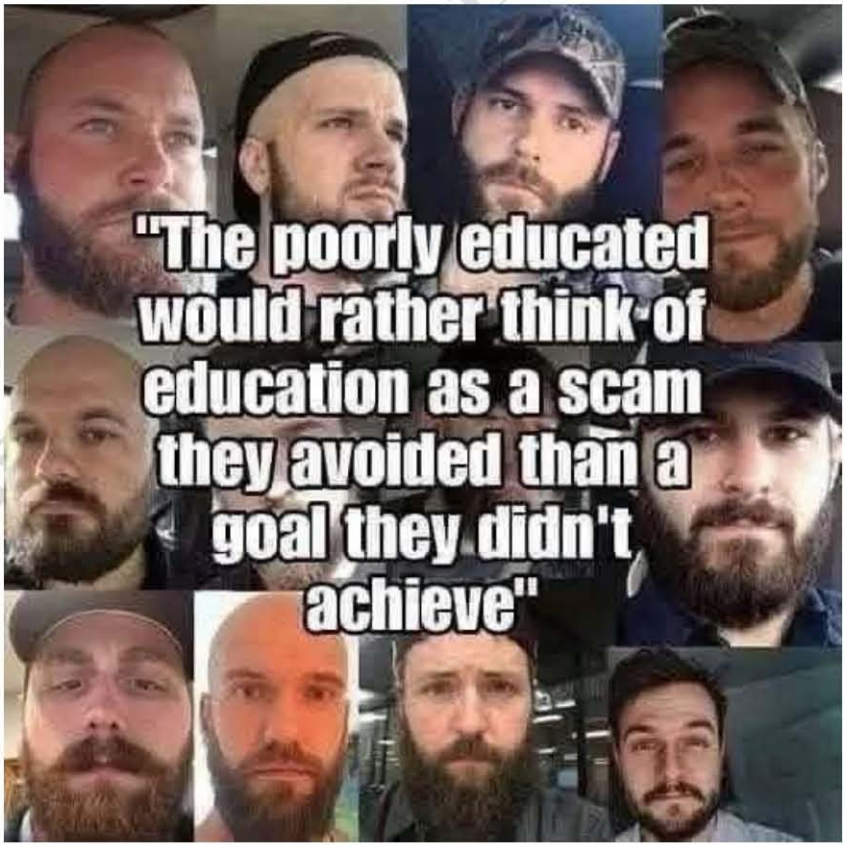


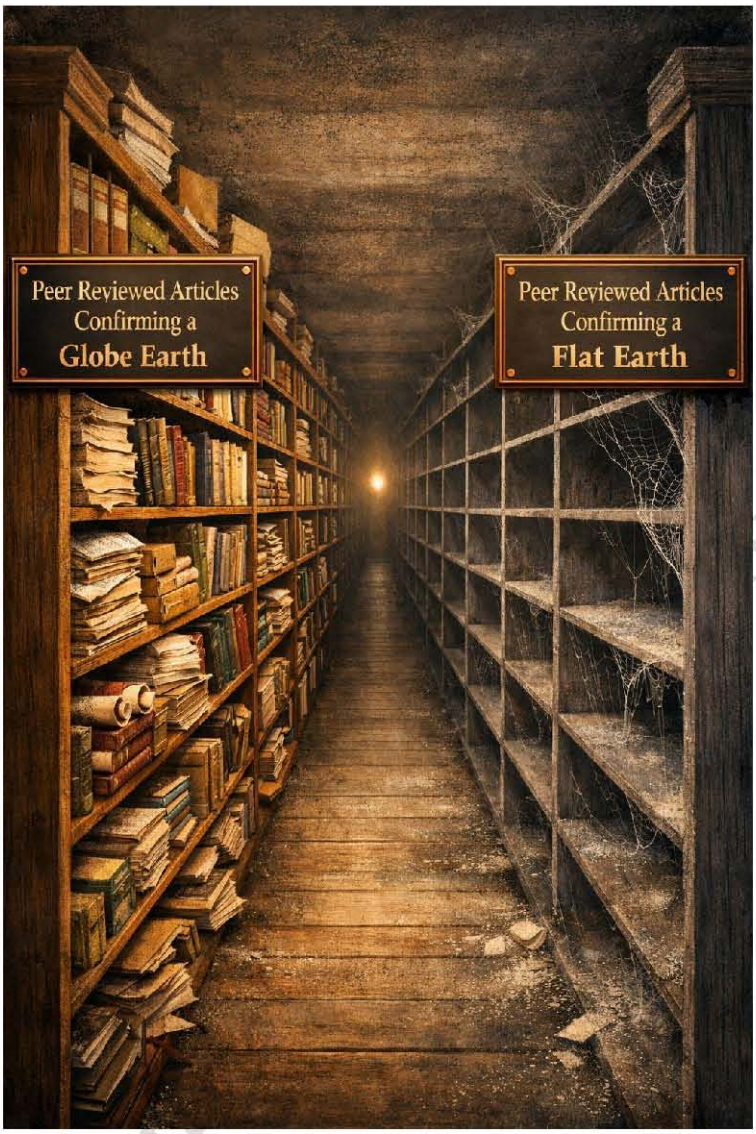
translation ongoing


I don't understand physics, so the Earth must be flat
I don't understand astronomy, so the earth must be flat
I don't understand math, so the Earth must be flat
I don't understand photography, so the Earth must be
we don't understand anything, so the Earth must be flat

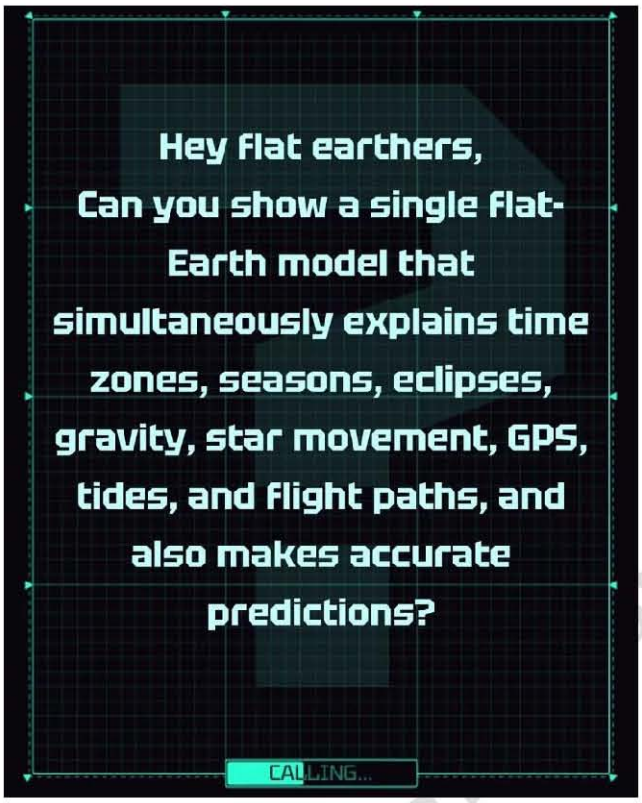
translation
going

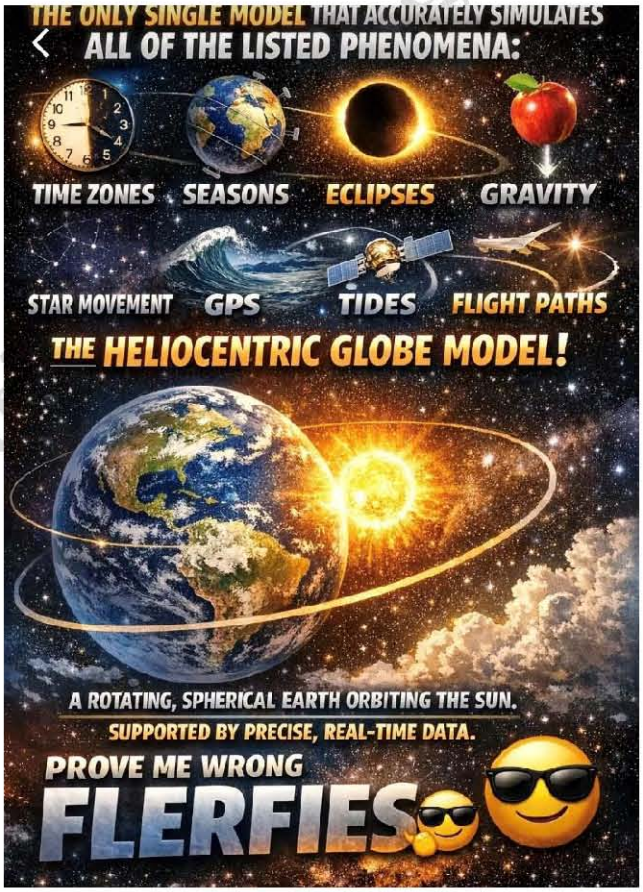
ALIEN BASE ON MOON?!
5G TOWERS EXPOSED
THE EARTH IS FLAT!
REPTILIAN EVIDENCE
GOVERNMENT LIES REVEALED!
i am a resurcher


"The poorly educated would rather think of education as a scam they avoided than a goal they didn't achieve"

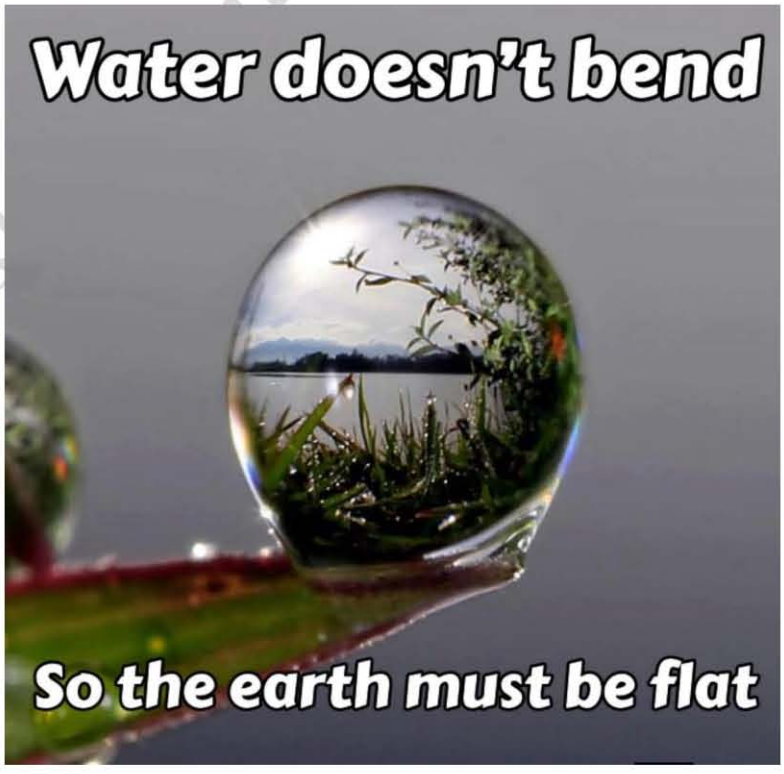


translation in progress

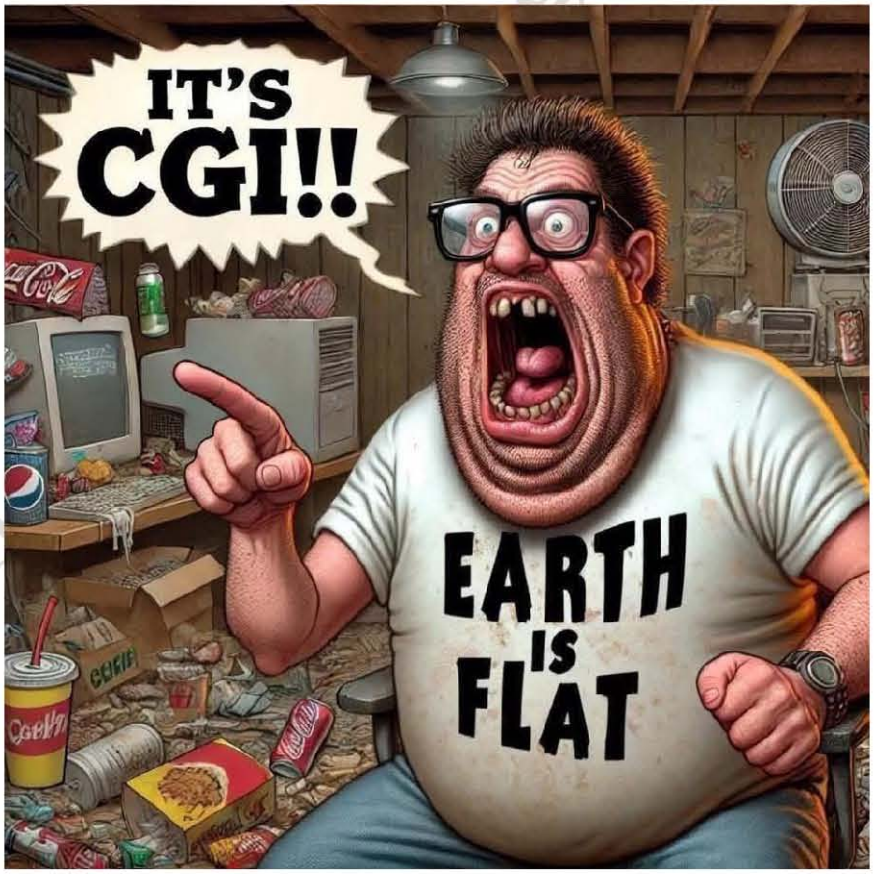

Hey flat earthers,
Can you show a single flat-Earth model that simultaneously explains time zones, seasons, eclipses, gravity, star movement, GPS, tides, and flight paths, and also makes accurate predictions?
CALLING...

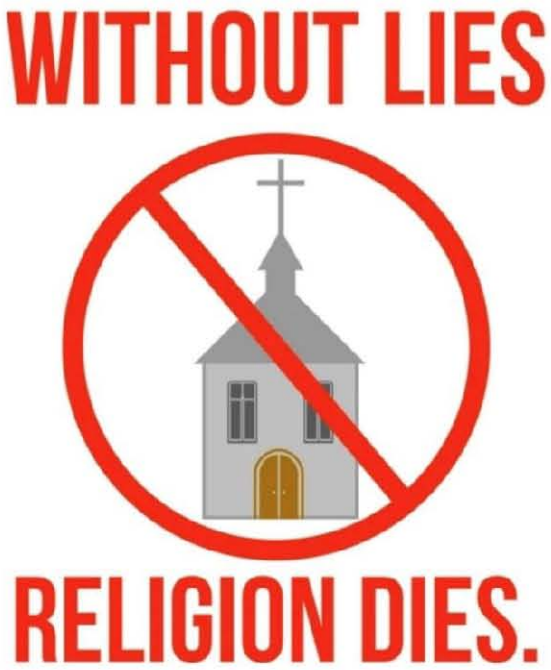

THE ONLY SINGLE MODEL THAT ACCURATELY SIMULATES
ALL OF THE LISTED PHENOMENA:
TIME ZONES
SEASONS
ECLIPSES
GRAVITY
STAR MOVEMENT
GPS
TIDES
FLIGHT PATHS
THE HELIOCENTRIC GLOBE MODEL!
A ROTATING, SPHERICAL EARTH ORBITING THE SUN.
SUPPORTED BY PRECISE, REAL-TIME DATA.
PROVE ME WRONG
FLERFIES

"Zoom in and the bottom will appear..."
No, it won't

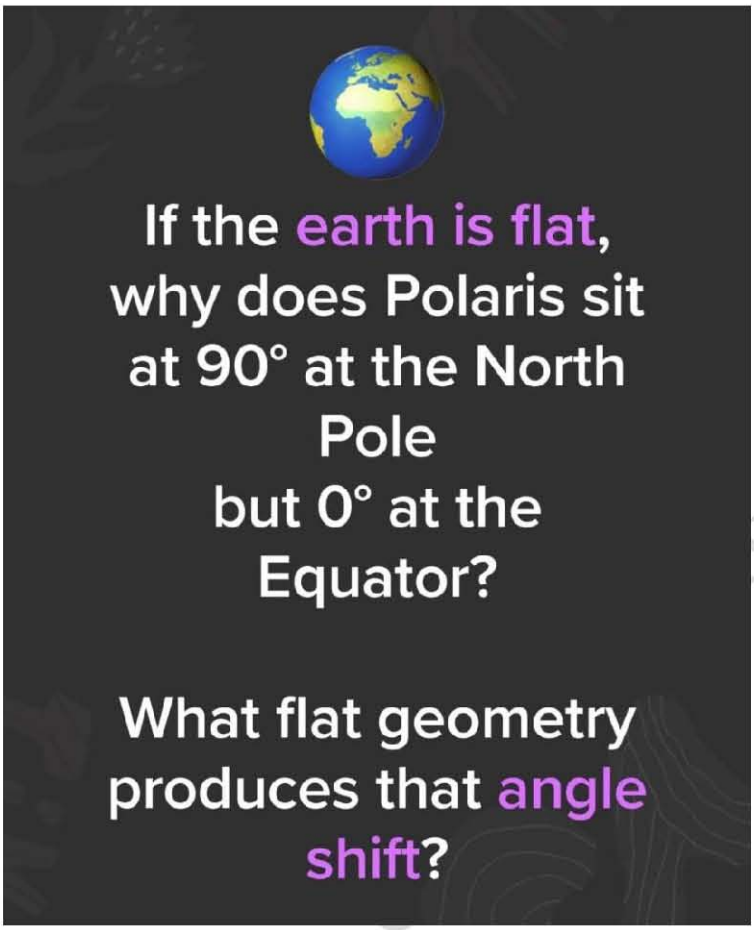

Water doesn't bend
So the earth must be flat

TOO DUMB TO UNDERSTAND?
SIMPLY CLAIM IT'S FAKE!


IT'S CGI!!
EARTH IS FLAT


WITHOUT LIES
RELIGION DIES.

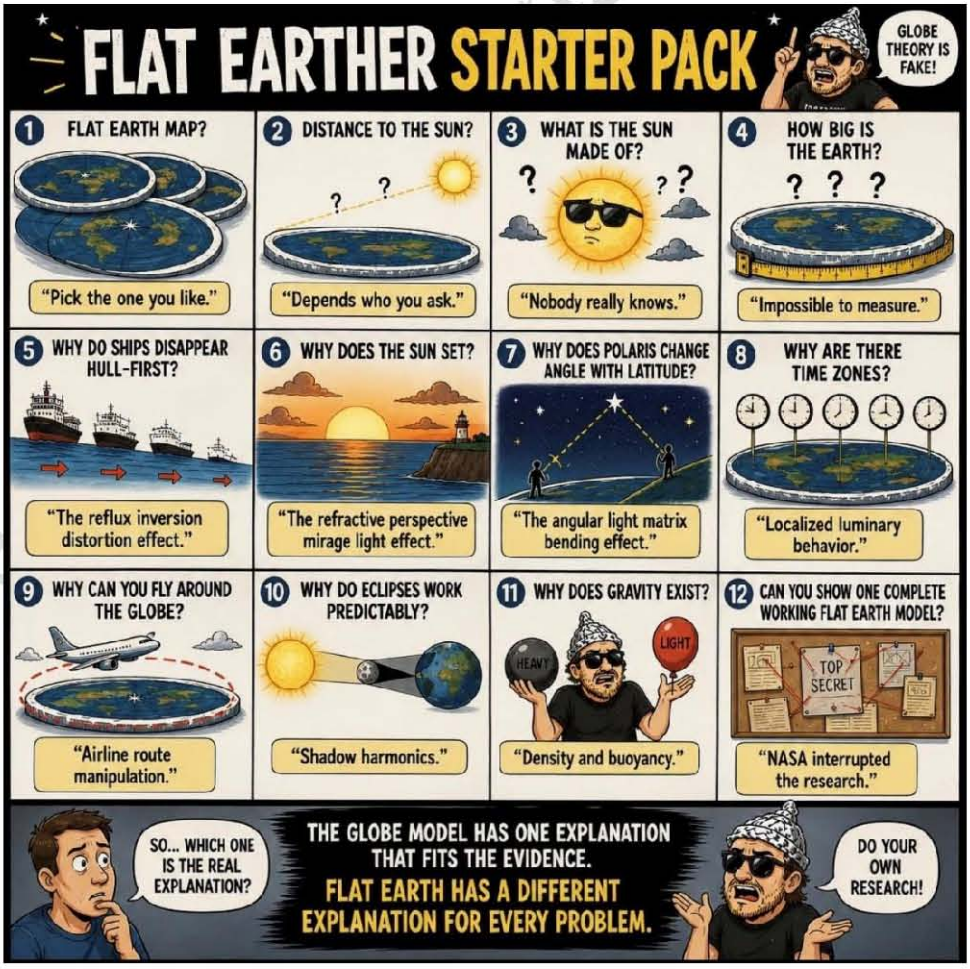
..this is it..
-this is
all you got
..and you say
NASA makes
cartoons?



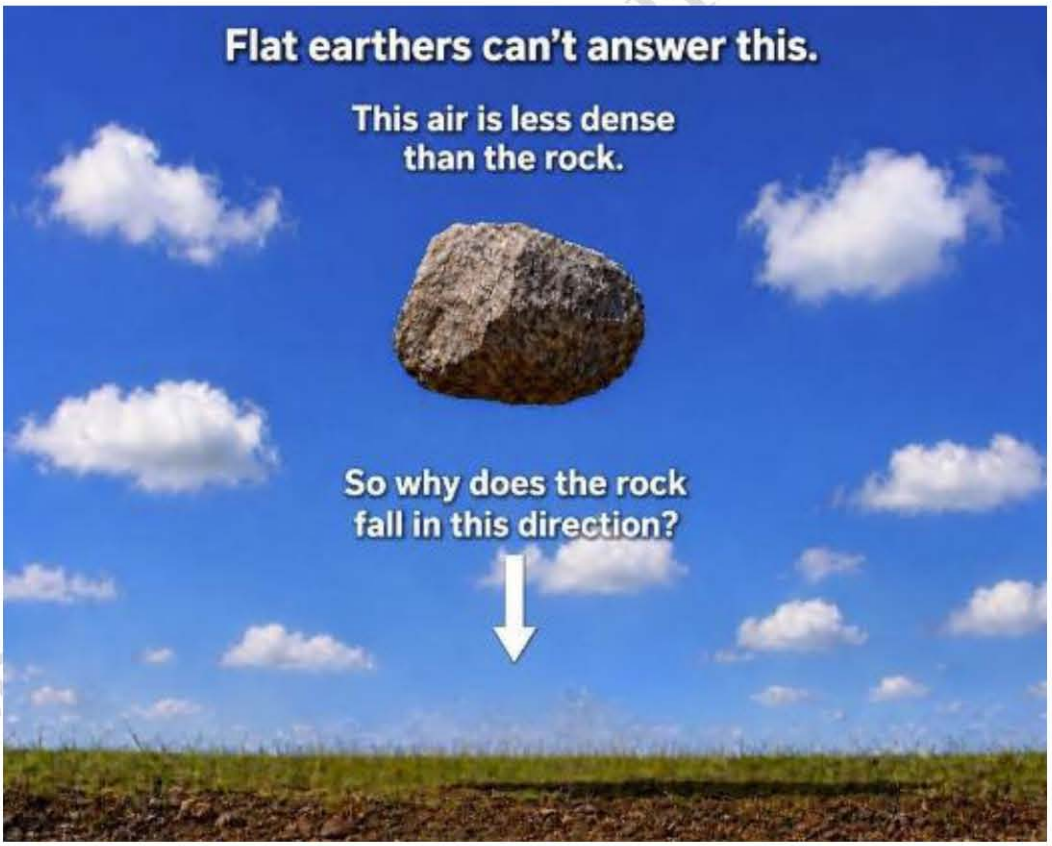
translation ongoing

DIDN'T GET ENOUGH ATTENTION IRL?
NEVER AS POPULAR AS YOU'D LIKE?
0
BECOME A CONSPIRACIST ON FB
THAT CALLS PEOPLE SHILLS.
THE TRUTH THEY DON'T WANT YOU TO KNOW!
SHEEPLE!
YOU'RE ALL SHILLS!
DO YOUR RESEARCH!
WAKE UP SHEEPLE!
ALWAYS FELT LOOKED DOWN UPON AND DUMB...
RESENTFUL OF PEOPLE WITH ACTUAL HARD-EARNED EDUCATIONS?
UNIVERSITY
WATCH A FEW YOUTUBE VIDEOS CALL IT "RESEARCH"
POST TONS OF HORSESHIT YOU CAN'T EXPLAIN
WAKE UP!!! THEY'RE LYING TO YOU!!! DO YOUR OWN RESEARCH!!!
632
142 Comments
THINK YOU'RE AWESOME
GET LIKED BY THE SAME TYPE OF ILLITERATE DUMBBASSES WHO "RESEARCHED" JUST LIKE THEY DID.
YEP!
SO TRUE!
EXACTLY!
DO YOUR RESEARCH!
TRUST NO ONE!
MAGA
FAKE SMART. LOUD. WRONG.
CONFIDENT IN THEIR IGNORANCE.

FLAT EARTH LOGIC
Light only travels so far.
Zooming in fixes that.


FLAT EARTHER STARTER PACK
GLOBE THEORY IS FAKE!
1 FLAT EARTH MAP?
"Pick the one you like."
2 DISTANCE TO THE SUN?
"Depends who you ask."
3 WHAT IS THE SUN MADE OF?
"Nobody really knows."
4 HOW BIG IS THE EARTH?
"Impossible to measure."
5 WHY DO SHIPS DISAPPEAR HULL-FIRST?
"The reflux inversion distortion effect."
6 WHY DOES THE SUN SET?
"The refractive perspective mirage light effect."
7 WHY DOES POLARIS CHANGE ANGLE WITH LATITUDE?
"The angular light matrix bending effect."
8 WHY ARE THERE TIME ZONES?
"Localized luminary behavior."
9 WHY CAN YOU FLY AROUND THE GLOBE?
"Airline route manipulation."
10 WHY DO ECLIPSES WORK PREDICTABLY?
"Shadow harmonics."
11 WHY DOES GRAVITY EXIST?
HEAVY
LIGHT
"Density and buoyancy."
12 CAN YOU SHOW ONE COMPLETE WORKING FLAT EARTH MODEL?
TOP SECRET
"NASA interrupted the research."
SO... WHICH ONE IS THE REAL EXPLANATION?
THE GLOBE MODEL HAS ONE EXPLANATION THAT FITS THE EVIDENCE.
FLAT EARTH HAS A DIFFERENT EXPLANATION FOR EVERY PROBLEM.
DO YOUR OWN RESEARCH!

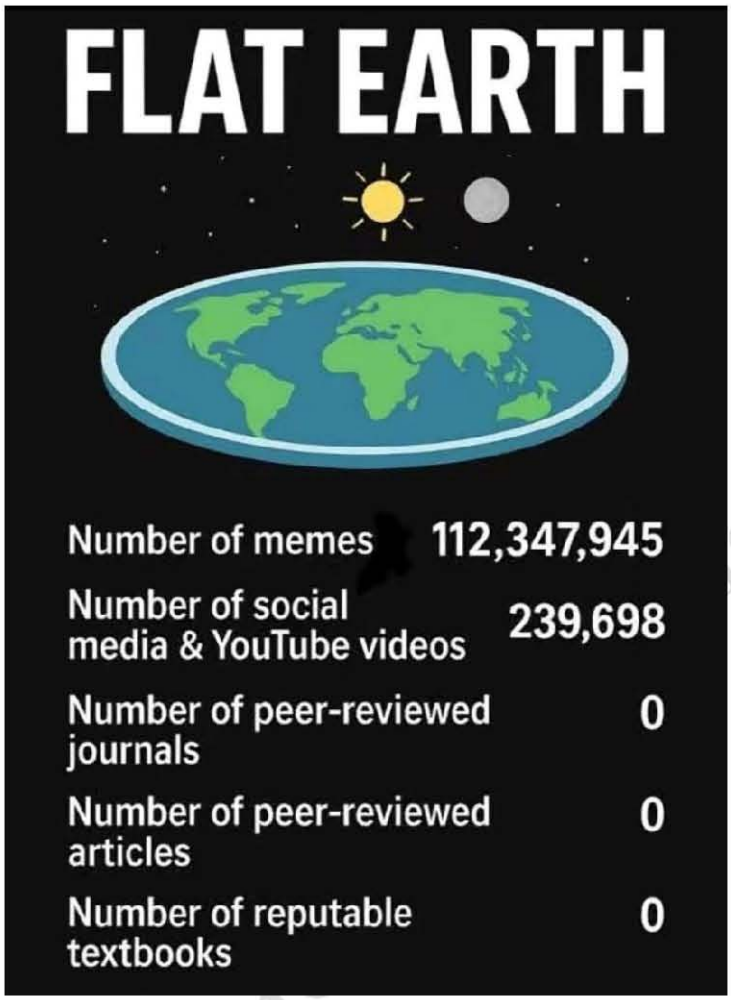
SPACE IS FAKE
EARTH IS FLAT
NO SUCH THING AS GRAVITY
CGI
WE'RE AWAKENED TO THE TRUTH


Flat earthers can't answer this.
This air is less dense than the rock.
So why does the rock fall in this direction?

"I DID MY RESEARCH"

THERE'S A DIFFERENCE.

REAL RESEARCH	WHAT FLAT EARTHERS DO
LEARN THE MODEL Understand the globe model before criticizing it. ✓	**WATCH YOUTUBE VIDEOS** Take content as truth without understanding the topic. ✗
USE PRIMARY SOURCES & REAL DATA Read papers, books, check measurements, look at raw data. ✓	**BELIEVE MASSIVE UNSUPPORTED CONSPIRACIES** Accept incredible claims with no evidence. ✗
CONSIDER ALL EVIDENCE Look at both sides and follow the evidence wherever it leads. ✓	**CHERRY PICK** Focus only on things that seem to support flat Earth and ignore the rest. ✗
UNDERSTAND THE SCIENCE Learn the math, physics, geometry and scale. ✓	**DON'T UNDERSTAND THE SCIENCE** Don't learn the math, misunderstand basic physics and scale. ✗
USE MODELS THAT MAKE PREDICTIONS Good models explain everything and make accurate predictions. ✓	**HAVE NO WORKING MODEL** Flat Earth can't explain everything or make accurate predictions. ✗
QUESTION THEIR OWN IDEAS Challenge beliefs, find answers, and update beliefs when needed. ✓	**NEVER QUESTION THEIR MODEL** Defend their model at all costs. Find excuses for failures. instead of answers. ✗
FOLLOW THE EVIDENCE Conclusion is based on evidence, not feelings or beliefs. ✓	**REFUSES TO CHANGE MIND** No amount of evidence will change their conclusion. ✗


FLAT EARTH
Number of memes 112,347,945
Number of social media & YouTube videos 239,698
Number of peer-reviewed journals 0
Number of peer-reviewed articles 0
Number of reputable textbooks 0

FLAT EARTHERS BE LIKE:
"THE SUN IS LOCAL AND IN THE CLOUDS!"
SEE? RIGHT THERE IN THE TREE!
YEP, TOTALLY MAKES SENSE.
THE SUN NOW COMES WITH LEAVES AND BRANCHES.
NEXT MODEL UPDATE: SUN HANGS FROM A BIRDHOUSE.
RESEARCH
FLAT EARTH

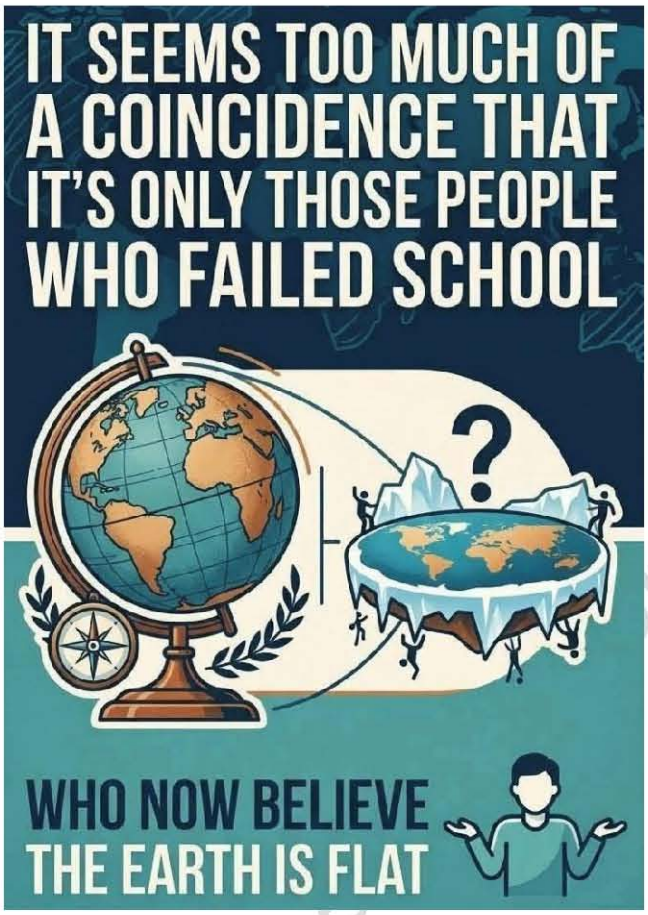
A normal telescope

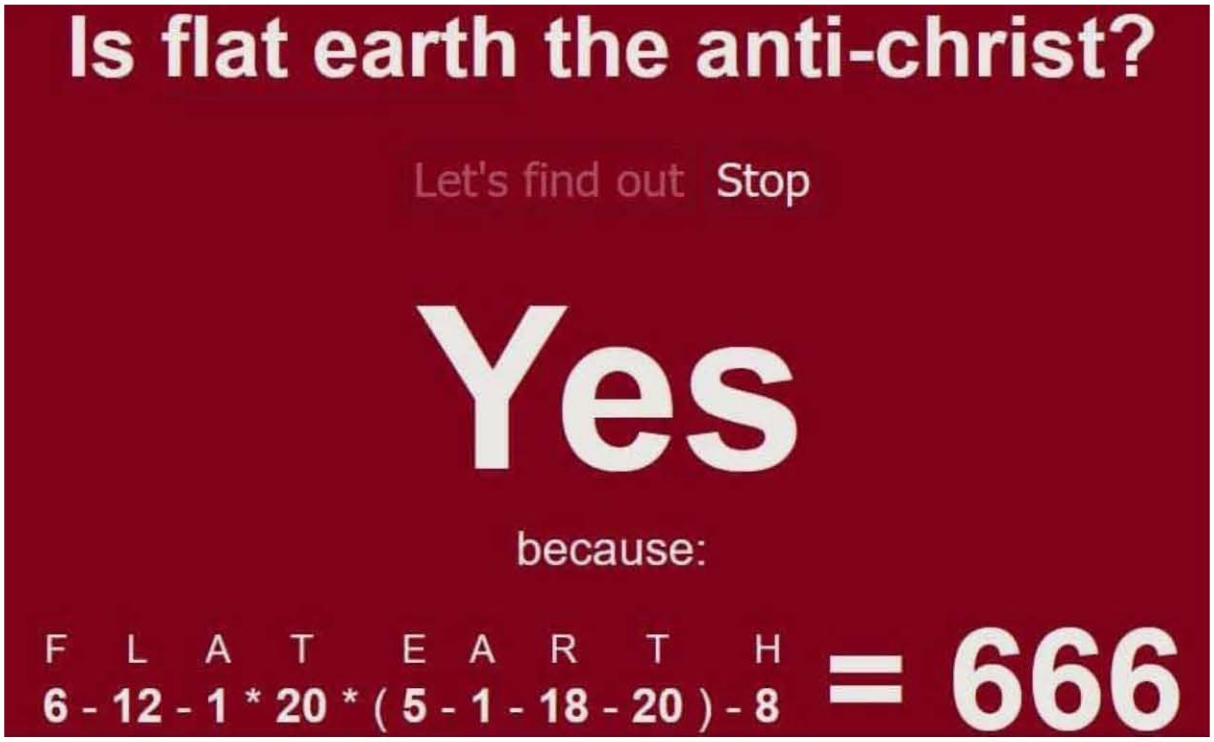
A flat earther's
Telescope

REMEMBER THAT TIME 2 FLAT EARTHERS PROVED THE GLOBE??
THAT WAS AWESOME

THANKS BOB

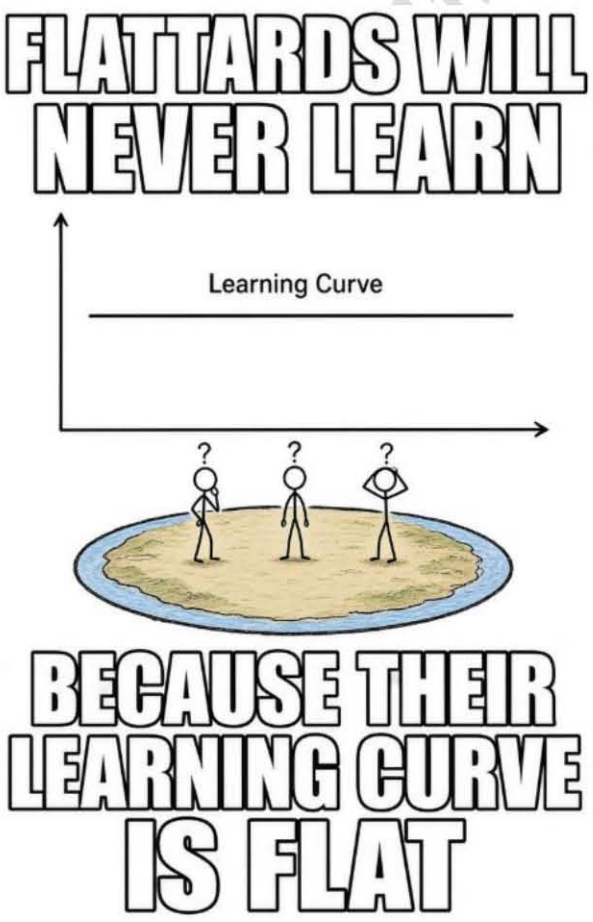
17 ft.
17 ft.
23 ft.
THANKS JERAN

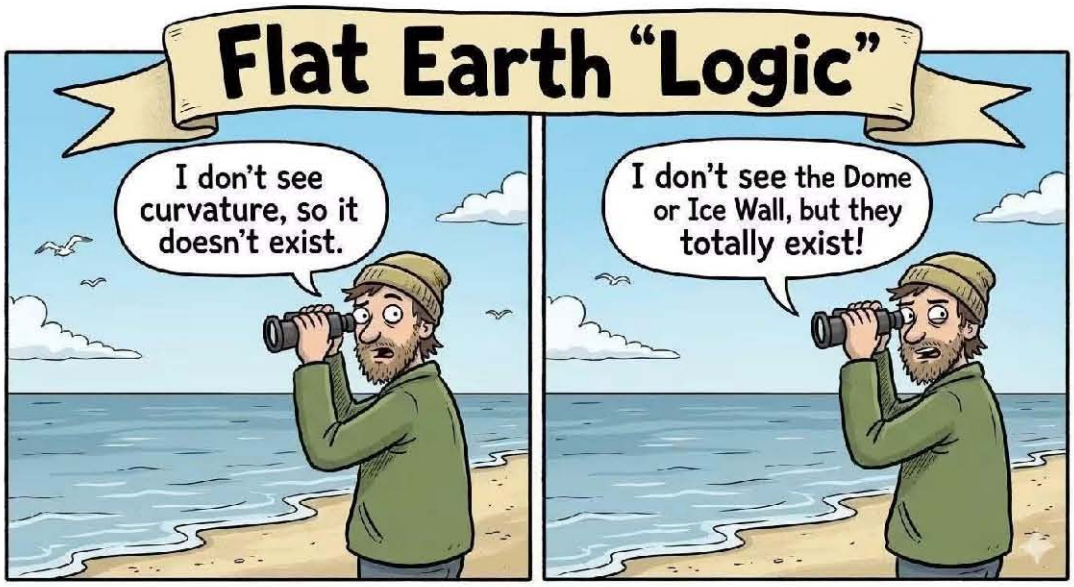

IT SEEMS TOO MUCH OF A COINCIDENCE THAT IT'S ONLY THOSE PEOPLE WHO FAILED SCHOOL
?
WHO NOW BELIEVE THE EARTH IS FLAT

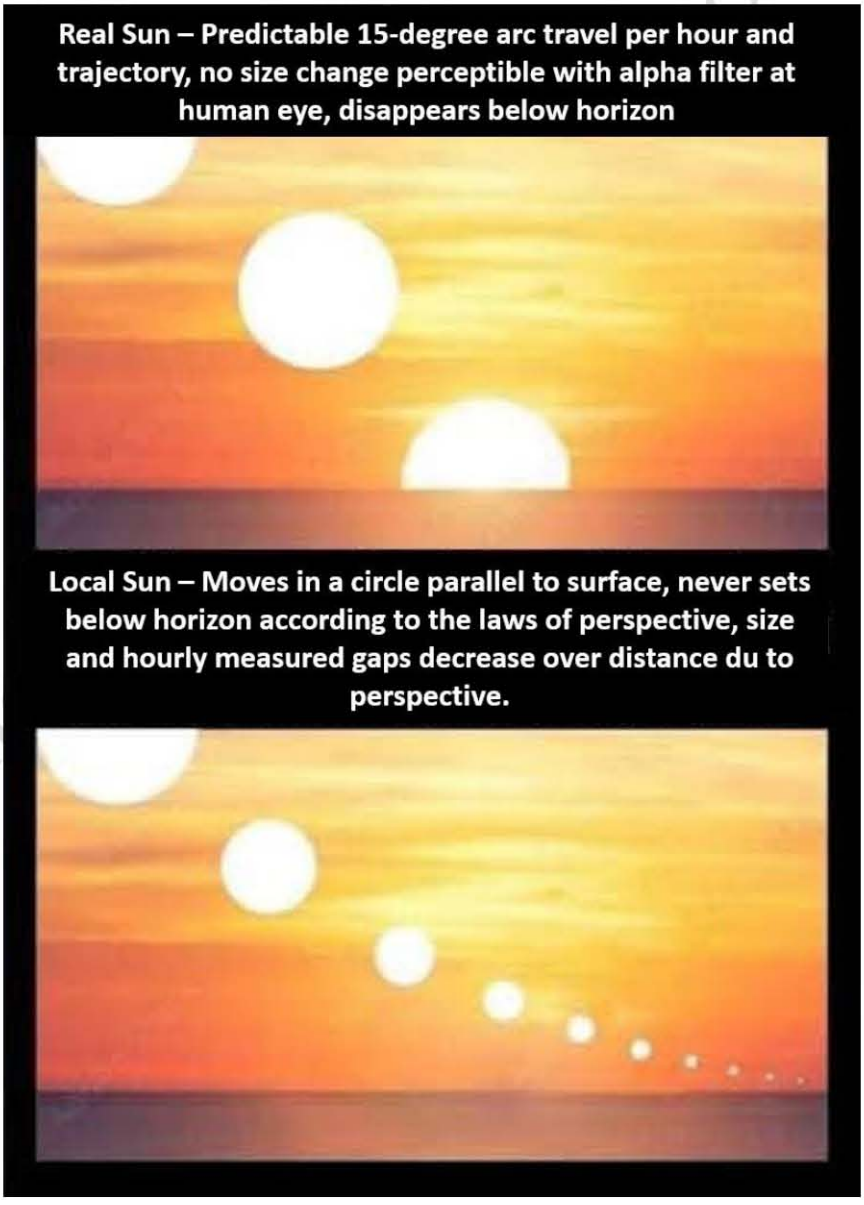

Is flat earth the anti-christ?
Let's find out Stop
Yes
because:
F L A T E A R T H
6 - 12 - 1 * 20 * (5 - 1 - 18 - 20) - 8 = 666

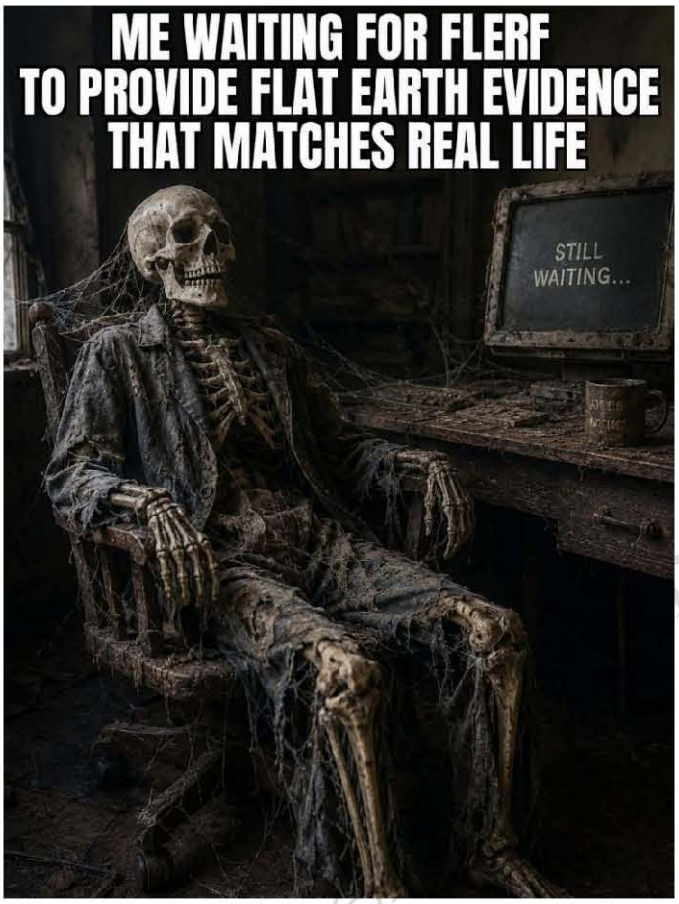
Flat earthers on a train:

It doesn't feel like we're going 200 mph. It feels like we're stationary.
Those distant mountains are barely moving. Shouldn't they be flying past me at 200 mph?
I threw a ball in the air and it didn't fly to the back of the train! It's like we're not even moving!




Flat Earth "Logic"
I don't see curvature, so it doesn't exist.
I don't see the Dome or Ice Wall, but they totally exist!


Real Sun – Predictable 15-degree arc travel per hour and trajectory, no size change perceptible with alpha filter at human eye, disappears below horizon
Local Sun – Moves in a circle parallel to surface, never sets below horizon according to the laws of perspective, size and hourly measured gaps decrease over distance du to perspective.



translation into e ngoing

INDEX

A

abductive statistics, 50
airplane, 148
Al Biruni's Experience, 154
analema, 313
angle of depression, 157
angle of depression experiment, 211
anti-twilight arch, 466
araucaria columnaris, 566
ArcGIS, 625
atmosphere, 578
AutoCAD, 621
Autodesk, 621

B

Bonneville Salt Flats, 109
Burj Khalifa, 112

C

Celestron, 143
CERN, 605, 607
circumnavigation, 232
circumpolaire, 232
citations, 747
Coriolis force, 541
cosmic rays, 474
crepuscular rays, 296
curvature from airplane, 195
curvature visible from rockets, 209

D

Daytona International Speedway, 675
declination experiment, 177
depression, 156
diurnal libration, 429

E

ECDIS, 623
Elecktro-L, 24
encyclopadia, 694
equinoxes, 330
Eratosthenes' experiment, 151
Eratosthenes poject, 152
ESA, 23
expérience de Bedford Level, 158

F

FIG, 483
Foucaualt pendulum, 554
Foucault, 554

G

G.P.S., 400
general relativity, 222
Globus INK, 445
gravimetry, 51
gravitational locking, 420
Gravity Probe B, 225

H

Hafele-Keating experimental, 222
hidden height, 58
High Energy Accelerator Research Organization, 613
Horizon-o-Matic experiment, 168
Hwasong, 22

I

ICA, 483
IHO, 482, 483
International Cartographic Association, 483
International Federation of Surveyors, 483
International Hydrographic Organization, 482, 483
International Linear Collider, 619
international standard, 489
international telecommunication union, 485
ISO, 489
ITU, 485

J

JAXA, 20

K

KEK, 613
Krakatoa, 586
Krakatoa volcano, 586

L

lake Pontchartrain, 82
Large Hadron Collider, 607
LASER, 527
LHC, 607
light curvature, 391

M

meridian, 524
meter, 526
Midnight Sun, 667

translation into english ongoing

modeling basin, 101, 104
MTG-I1, 23
musulman, 706

N

NATA, 22
National Accelerator Laboratory, 609
navigateurs, 764
neutrinos, 629
NHST
    null hypothesis statistical testing, 797

O

oil plateform, 89
oil platforms, 88

P

panoramas, 34
pastafarism, 708
photo, 23, 24
photos, 20
plumb line, 171
plumb line experiment\, 171
plumb lines, 123
pont Humber Bridge, 96
pont Vasco de Gama, 126
Pontchartrain bridge, 82
Pontchartrain lake, 92

R

radio, 529
rail, 122
rails, 102
Rainy Lake experiment, 159
religions, 707
ROSCOSMOS, 24

S

seismic waves, 536
skippeurs, 764
SLAC, 609
solstice, 313, 337, 343
spirit level, 174
spirit level experiment, 174
SPS, 605
Stanford Linear Accelerator Center, 609
summer solstice, 337
sun distance, 166
Super Proton Synchrotron, 605
surveyor, 483

T

Tevatron, 611
The Final Experiment, 659
theodolite, 171
theodolite, 510
théorème isopérimétrique, 801
time zone, 391
Tonga, 582
Tonga volcano, 582
total station, 510
tree, 566

V

Vendée Globe, 672
Venus's belt, 466
viewpoint, 34
volcanic eruptions, 582

W

weather balloon, 163, 179
Wikipedia, 694
wind farm, 85
winter solstice d'hiver, 343

translation into english ongoing

More than 300 proofs that the Earth is not flat

It is difficult to make a person, especially an adult, abandon their belief. As belief is not a rational process, any refutation based on rational arguments will be in vain. Moreover, attacking someone's belief or faith by trying to show them that they are wrong is often perceived as an aggression; not only an intellectual aggression but also a social aggression towards their community of thought and a cultural aggression towards their belief. Challenging their flat-Earth ideas would mean denying years of trust or reflection.

As scientists, engineers, or enthusiasts of the scientific method, we can however act on several levels with young people before it is too late:

- Reminding them of what is known through elements of the History of science and epistemology;
- Teaching them how to use and evaluate the information sources they encounter and place them on the 15 levels of scientific evidence;
- Giving them the ability to distinguish between "faith," "belief," and "credence" (likelihood);
- Teaching them the scientific method and the complex concepts related to it, but in a highly simplified manner corresponding to their current educational level;
- Reminding and demonstrating to them that any analogy is a false equivalence;
- Convincing them, ideally through rigorous experimentation, that hundreds of cognitive biases insidiously intervene when we evaluate information (scientific or otherwise);
- Giving them the means to delve deeper on their own by providing or distributing high-quality academic resources for free.

This booklet is based on this approach to demonstrate that flat-earthers are unfortunately indoctrinated people, deceitful, dishonest, mythomaniacs, or suffering from mental disorders for various reasons and provides the intellectual and technical tools to counteract their fallacious rhetoric.

ISBN number: -
DOI number: -